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CENTRE FOR INTERNET AND DIGITAL ECONOMY

State of India's Digital Economy

2024

State of India's Digital Economy (SIDE) Report, 2024

Deepak Mishra, Mansi Kedia, Aarti Reddy, Krithika Ramnath and Mayank Manish

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The State of India's Digital Economy Report

2024

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All errors remain our own.

Glossary

5G	Fifth-generation technology standard for cellular networks
AA	Account Aggregator
ABDM	Ayushman Bharat Digital Mission
ABHA	Ayushman Bharat Health Account
AI	Artificial Intelligence
API	Application Programming Interface
AR/VR	Augmented Reality / Virtual Reality
BFSI	Banking, Financial Services and Insurance
BHIM	Bharat Interface for Money
BTS	Base transceiver station
CAG	Comptroller and Auditor General of India
CAGR	Compound Annual Growth Rate
CCTNS	Crime and Criminal Tracking Network and Systems
CERT-In	Indian Computer Emergency Response Team
CHIPS	Connect, Harness, Innovate, Protect and Sustain
CIDR	Central Identities Data Repository
CO2e	Carbon dioxide equivalent
CoWIN	Covid Vaccine Intelligence Network
CPI	Consumer Price Index
CSC	Common Services Centre
DBT	Direct Benefit Transfer
DDL	Digital Development Level
DeFi	Decentralized Finance
DEPA	Data Empowerment and Protection Architecture
DGSes	Digitised Government Services
DIGIT	Digital Infrastructure for Governance, Impact & Transformation
DILRMP-MIS	Digital India Land Records Modernization Programme
DIPA	Digital Infrastructure Providers Association
DoT	Department of Telecom
DPG	Digital Public Goods
DPI	Digital Public Infrastructure
DPIIT	Department for Promotion of Industry and Internal Trade
DSCI	Data Security Council of India
E-KYC	Electronic Know-Your-Customer

EGDI	E-Government Development Index
e-Taal	Electronic Transaction Aggregation & Analysis Layer
FDI	Foreign Direct Investment
Fintech	Financial technology
FY	Financial Year
G7	Group of Seven an intergovernmental forum
G20	Group of 20 intergovernmental forum
GB	GigaByte
GDP	Gross Domestic Product
GeM	Government e Marketplace
GFCF	Gross Fixed Capital Formation
GNI	Gross National Income
GSTN	Goods and Services Tax Network
Hz	Hertz
ICT	Information and Communications Technology
ID	Identity Document
IDI	ICT Development Index
INR	Indian National Rupee
IoT	Internet of Things
IT	Information Technology
ITES	Information Technology Enabled Services
ITU	International Telecommunication Union
JAM	Jan-Dhan-Aadhaar-Mobile
kbit/s	Kilobit per second
LDC	Least Developed Countries
LLDC	Land Locked Developing Countries
MB	MegaByte
Mbps	Megabits Per Second
MDR	Merchant Discount Rate
MeitY	Ministry of Electronics and Information Technology
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MIS	Management Information Systems
ML	Machine Learning
MMP	Mission Mode Project
MoHFW	Ministry of Health and Family Welfare
MoHUA	Ministry of Housing and Urban Affairs
MOSIP	Modular Open-Source Identity Platform
MoU	Memorandum of Understanding

MSME	Micro, Small and Medium Enterprises
NASSCOM	National Association of Software and Service Companies
NBFCs	Non-Banking Finance Companies
NCRB	National Crime Records Bureau
NCSI	National Cybersecurity Index
NeGP	National e-Governance Plan
NeSDA	National e-Governance Service Delivery Assessment
NFHS	National Family Health Survey
NIC	National Informatics Centre
NLP	Natural Language Processing
NPCI	National Payments Corporation of India
NRI	Network Readiness Index
NSAP	National Social Assistance Programme
NSSO	National Sample Survey Office
NSS MIS	National Sample Survey - Multiple Indicator Survey
OTT	Over the Top
P2P	Peer-To-Peer
PDS	Public Distribution System
PPP	Purchasing Power Parity
RBI	Reserve Bank of India
R&D	Research & Development
RRBs	Regional Rural Banks
SDC	State Data Centre
SEBI	Securities and Exchange Board of India
SIDE	State of India's Digital Economy
SMS	Short Message Service
SWAN	State Wide Area Networks
TRAI	Telecom Regulatory Authority of India
UDISE	Unified District Information System for Education Plus
UHI	Unified Health Interface
UIDAI	Unique Identification Authority of India
ULBs	Urban Local Bodies
UN	United Nations
UPI	Unified Payments Interface
USD	United States Dollar
USOF	Universal Service Obligation Fund
UT	Union Territory
WiFi	Wireless Fidelity

Executive Summary

A new way to measure digitalisation: The CHIPS framework

Digitalisation has made dramatic progress, but the way it is being measured has not. Three of the most widely cited global indices on digitalisation were conceived nearly two decades ago – the E-Government Development Index (EGDI), produced by the United Nations, first published in 2001, the Network Readiness Index (NRI), conceived at Harvard University, launched in 2002, and the International Telecommunication Union's ICT Development Index (IDI), first released in 2009. At the time of their conceptualisation, digitalisation was largely defined by access; more specifically, access to the internet through fixed broadband. Developing countries – both because of their limited resources and the conviction that they could leapfrog through various stages of digital transformation – have travelled a different path towards digitalisation than that by their developed country counterparts. Despite having evolved, existing global indices put "connectivity of the individual user" at the centre, presenting an incomplete picture of digitalisation in developing countries, including that of India.

The State of India's Digital Economy (SIDE) 2024 presents a new approach to measure digitalisation. This approach is better suited for developing countries like India for three reasons. First, it proposes a much wider definition of digitalisation through its Connect-Harness-Innovate-Protect-Sustain (CHIPS) framework, capturing both the opportunities and risks created by digitalisation. Second, unlike global indices that focus entirely on the average user, SIDE 2024 recognises the scale of the network and depth of use of technology at the economy-wide level by proposing two separate indices – CHIPS (Economy) and CHIPS (User). Finally, while most global indices focus on both outcomes and inputs (enablers) of digitalisation – thus penalising developing countries twice, once for a low score on outcome and then again for a low score on inputs – CHIPS is almost entirely estimated using outcome indicators.

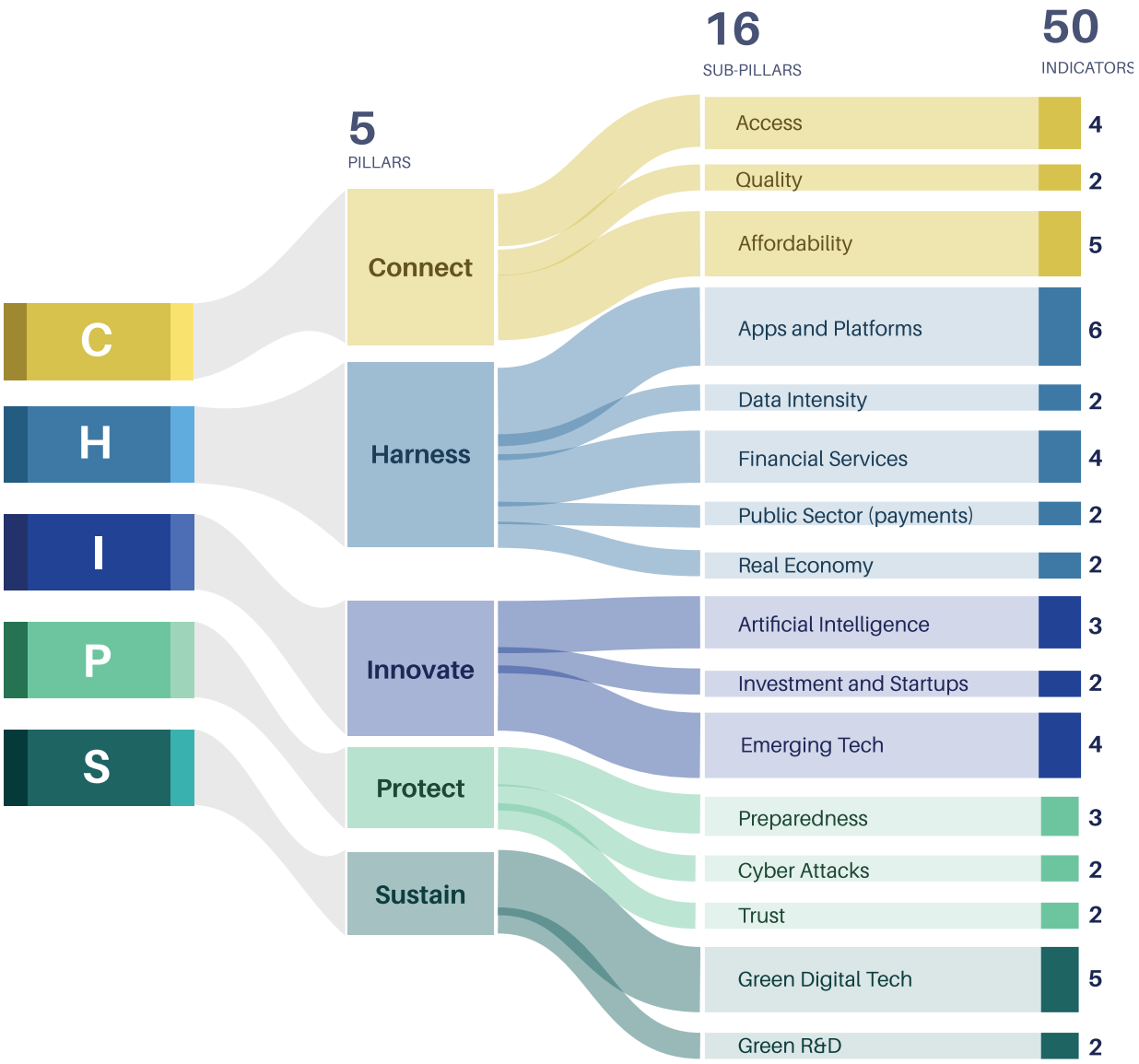
The CHIPS framework has three tiers: pillars, sub-pillars and indicators. The five pillars – Connect, Harness, Innovate, Protect and Sustain – measure the entire spectrum of digital transformation (see Figure ES1). The five pillars are classified into 16 sub-pillars, that are further categorised into 50 indicators. Many indicators in our framework overlap with the global indices, though we also introduce several new ones (see Annexure 1 and 2 for more details). We also extend the CHIPS framework to the sub-national level, enabling comparison of the level of digitalisation across 28 Indian states and 8 union territories (UTs).

India is the third largest digitalised country in the world

When compared by their aggregate level of digitalisation, India ranks as the third largest digitalised country in the world, behind the US and China, and ahead of the UK, Germany and Japan (see Table ES1). While the US ranks first with a score of 65 and China a close second with 62, India is a distant third with a score of 39, followed by the UK (29), Germany (24) and South Korea (22). India's third rank is driven by two scale-driven pillars, Connect and Harness, that collectively contribute 66 per cent to India's total score. At the sub-pillar level, India seems to be operating at the global frontier in six sub-pillars (cyber attacks, affordability, access, public sector (payments), real economy and trust), at a moderate distance from the global frontier in seven sub-pillars (apps and platforms, AI, green digital tech, data intensity, quality, investments and start-ups and financial services), and far away from the frontier in three sub-pillars (emerging technology, preparedness and green R&D).

FIGURE ES 1

The CHIPS framework



Source: IPCIDE Research

Highly digitalised nation, moderately digitalised users

While India as a nation is vastly digitalised, the average user is not. This explains why India is ranked 12th among the G20 countries in terms of level of digitalisation of the user, i.e., by CHIPS (User), as shown in Table ES 1. This is not entirely unexpected, as India is the poorest country in the G20, and consumption of digital goods and services exhibit strong positive correlation with per capita income. But even by this criterion, India's score is higher than all G20 developing countries except China and Argentina, and is ranked above Italy, a G7 country. From the perspective of the experience of the average user, India is placed at the very bottom in the Connect and Harness pillars. Additionally, India's gender gap in internet connectivity at 10 per cent, is higher than the world average of 9 per cent. The rural-urban divide is even higher at 58 per cent, vis-à-vis the world average at 49 per cent. However, India continues to score high on the Innovate pillar, and accounts for nearly one-third of India's CHIPs (User) score. And within Innovate, the two biggest contributing sub-pillars are AI and start-ups. The fact

that India is doing well in the production of newer technologies (such as AI) but lags behind in the adoption of older basic technologies (such as broadband and internet) is a reflection of its own intrinsic duality: the second highest IT services exporter in the world with the largest unconnected population.

Richer states are more digitalised than the poorer ones, but the dispersion within India is lower than between G20 countries

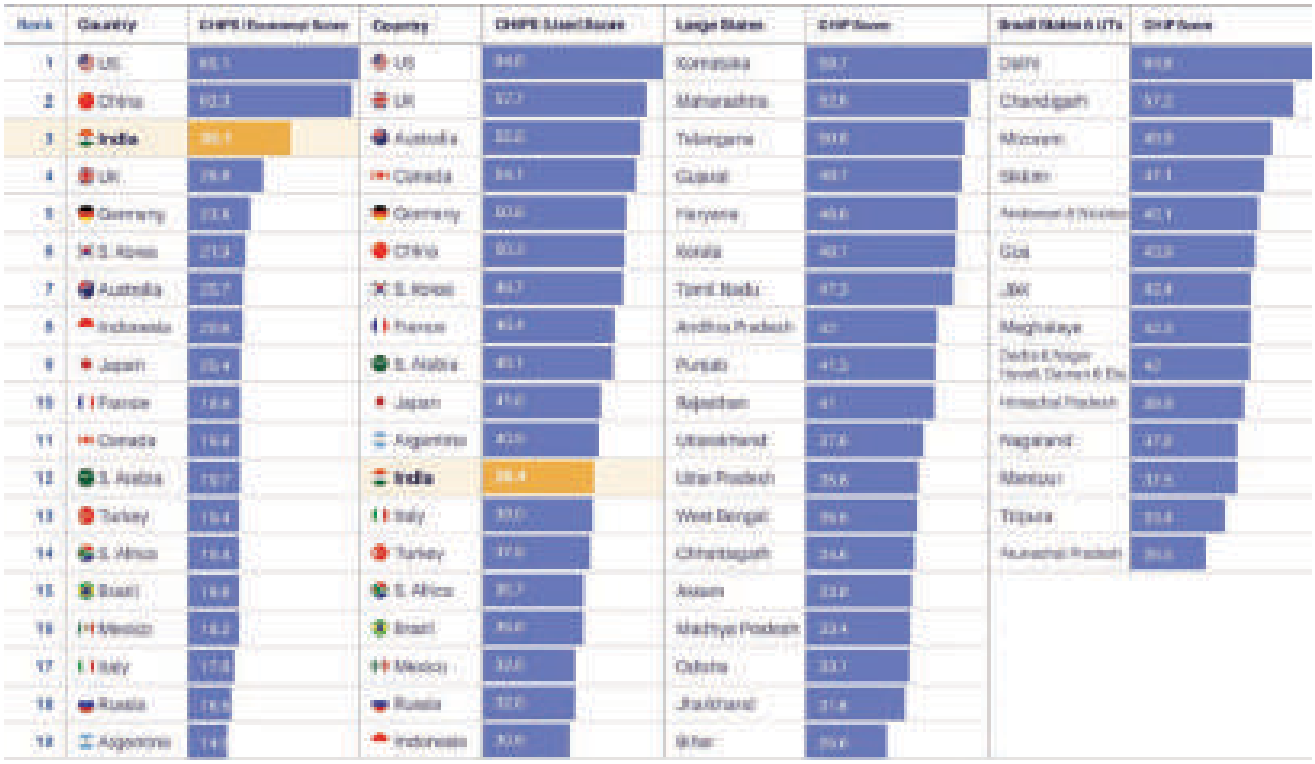
Richer states and union territories (UTs) in India have relatively higher levels of digitalisation than poorer states, but the gap is shrinking. The top 5 states according to CHIP score – Karnataka, Maharashtra, Telangana, Gujarat and Haryana – are also amongst the richer states in India. For UTs and smaller states (population less than 1 crore) as well, Delhi, Chandigarh are the top ranked UTs and also have the highest per capita income among UTs (see Table ES 1). No single state dominates the ranking table across the 14 different sub-pillars. For example, top five performer positions at the sub-pillar level are shared by nine different states. Interestingly, dispersion in the level of digitalisation when measured through the CHIP framework is found to be less unequal at the sub-national level than across G20 countries. The CHIP score for larger states in India have a smaller range (difference between the maximum and minimum value) compared to CHIP (User).

Both perspectives – aggregate and average user – are important for policymakers

The state of India's digital economy should include both the aggregate level as well the average user analysis. CHIPS (Economy) reflects the enormous scaling up that India has been able to achieve in connecting millions to the internet and enabling use of digital services at population scale. CHIPS (User) highlights India's record performance in AI and the start-up economy despite gaps in connectivity and persistent digital divides. Both perspectives are important for policymakers. The success of the DPI approach as a policy choice in providing scale should be celebrated, while the lack of basic infrastructure, challenges of affordability, and limited progress on greening its digital infrastructure should be scrutinised. An approach that combines the lens of CHIPS (Economy) and CHIPS (User), therefore, is an effective tool to measure digitalisation, especially for developing countries that do not walk the beaten path of developed countries.

TABLE ES 1

Measuring digitalisation using the CHIP(S) framework



** Ladakh and Lakshadweep are not included in the ranking due to unavailability of data for several indicators*
Both perspectives – aggregate and average user – are important for policy makers

Introduction

Digitalisation has made dramatic progress, but the way it is being measured has not

Limitation of existing global indices on digitalisation

India has made remarkable strides in digitalising its economy in recent years. It has the world's second largest mobile and internet network by number of users. It has rolled out 5G faster than all other countries. Few countries see data traffic per smartphone as high as is in India. Its digital identity network is amongst the world's largest. India also tops the world in terms of the volume of digital transactions, and export of ICT services. In the field of emerging technologies, India has become the largest contributor to global GitHub AI projects, and ranks third in the number of home-grown unicorns (see Box 1).[1] During its G20 Presidency, India was recognised as the champion of digital public infrastructures (DPIs), a new approach to population-scale delivery of public services (see Figure 1)

While India's progress in digitalisation is being globally acknowledged, it is still placed at the bottom half of most global rankings on digitalisation.[2] In the 2022 E-Government Development Index (EGDI) produced by the United Nations, India ranked 105, below small island economies such as Barbados (79), Fiji (97), and Maldives (104). The 2023 Network Readiness Index (NRI) ranked India at the 60th position, behind Ukraine (43) and Costa Rica (57). While the recently revamped International Telecommunication Union's (ITU) ICT Development Index (IDI) 2023 does not include India; its 2017 ranking had placed India at number 134, well behind Fiji (107) and Syria (126). The global rankings are, it seems, failing to adequately capture India's digi-

BOX 1

India's rapidly growing digital footprint

Mobile subscription. Of the estimated 8.36 billion mobile cellular subscriptions worldwide, 1.78 billion are in China followed by 1.14 billion in India and 372 million in the US.

Internet traffic. Average wireless data usage per subscriber per month in India was estimated at 18.39GB as of 30th June 2023, among the highest in the world.

5G deployment. The proportion of Indian users with 5G-capable devices that are using a 5G network increased 55 times – from 0.1% in September 2022 to 5.5% in January 2023, making it the fastest 5G deployment in any country.

Digital identity. India has given out over 1.3 billion biometric IDs as of January 8th, 2024.

Real-time digital payments. UPI transactions took place in India in FY 2022-23, the highest volume for any country. China is in the second place with 41.3 billion transactions (July 2023), marginally ahead of Brazil with 41 billion transactions in 2023.

ICT Service Exports. India is the second largest exporter of ICT services in the world (at 15.8% in 2022), behind Ireland (22.5 % in 2022).

AI Projects. India's contribution to GitHub for AI projects is the highest in the world at 23%, followed by US (14 %).

Unicorns. As of October 2023, the third highest number of home-grown unicorns by country were from India, following the US and China

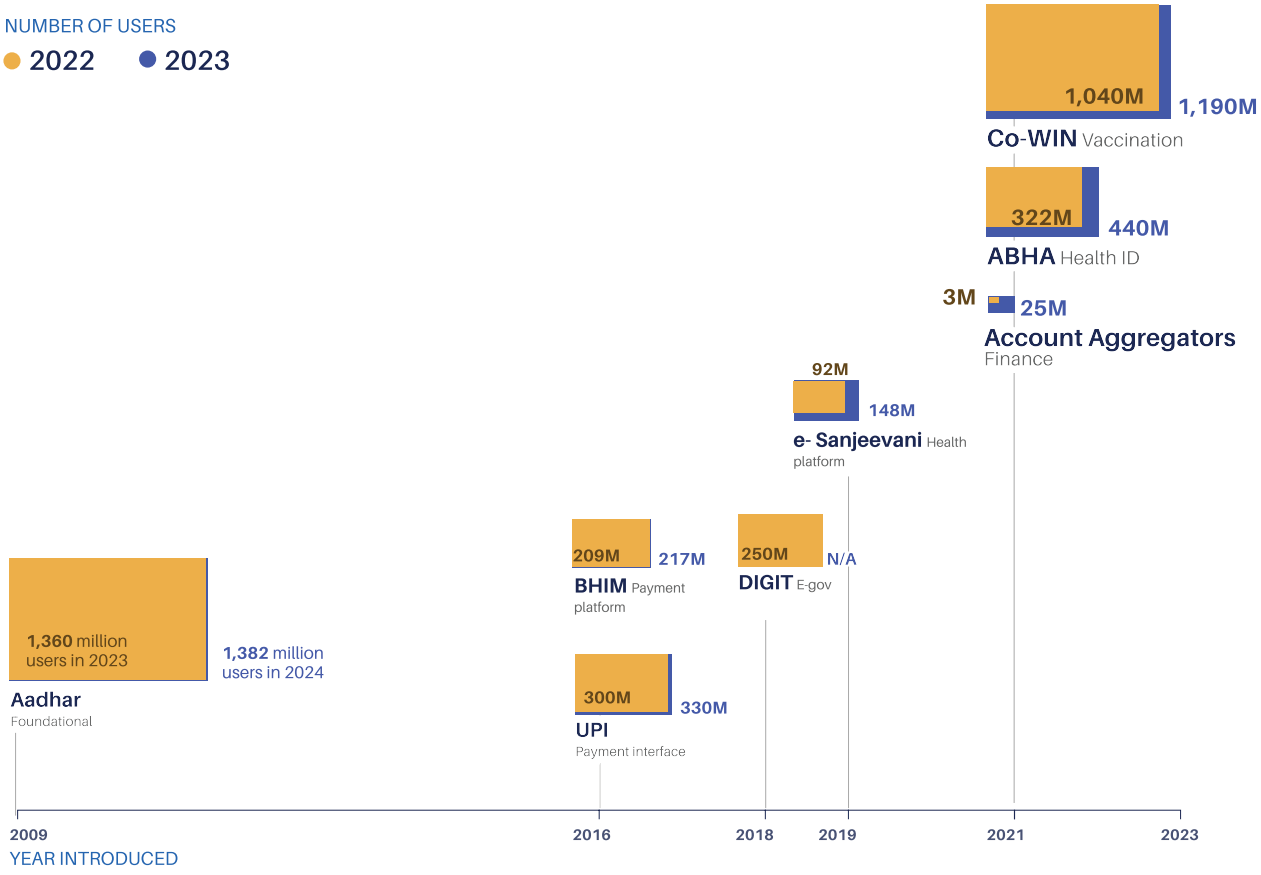
Sources: World Bank Databank, Nokia MBIT Index 2023, Ericsson Mobile Traffic Forecast, Ericsson Mobility Report 2023, GSMA, Speedtest Intelligence, UIDAI Aadhar Dashboard, Invest India, Banco Central Do Brasil Pix Key Statistics, NPCI Retail Payment Statistics, OECD.ai, China Internet Network Centre.

1 GitHub is an AI-powered platform that allows developers to create, store and manage their code, host APIs and collaborate with other coders.

2 Global publications like the Financial Times and the Economist have written about India's pioneering efforts in digitalisation, though largely in the context of its recent foray into digital public infrastructure (Refer Box 3)

FIGURE 1

Growing usage of DPIs – Progress from 2022 to 2023



Source: IPCIDE Research

tal progress.[3]

The inability of global indices to capture India's progress is not an India specific issue but applies to many developing countries that bypassed traditional digital technologies and adopted innovative and low-cost solutions because of resource and infrastructure constraint.[4,5] Some classic examples include Kenya's M-Pesa, launched in 2007, at a time when mobile and internet penetration in the country were 30.5 percent and 4.4 percent, respectively.[6] Most developing countries, skipped the landline and fixed broadband route, embracing a mobile-first telecom and internet network. Alibaba in China scaled its e-commerce platform on mobile technology at a time when internet penetration was very limited. India's DPI-led *Aadhaar* and Unified Payments Interface (UPI) helped scale access to public services among millions of unconnected rural residents through a combination of low bandwidth and offline options.[7] Digitalisation is therefore a broad concept with no globally agreed definition (see Box 2). In fact, the experience of developing countries shows that

3 The exception may be the World Economic Forum's Global Innovation Index, on which India ranked 40. But as shown later, even this ranking is lower than what we find using a methodology that is more relevant for the Indian context.

4 Fong, M, W.L. (2008). Technology Leapfrogging for Developing Countries. In Khosrow-Pour, M. *Encyclopaedia of Information Science and Technology, Second Edition.* 10.4018/978-1-60566-026-4. IGI Global.

5 Ramanathan, S. (2023, May 31). *The Role Of Leapfrog Innovation In Emerging Markets.* Forbes.

6 Dey, S. (2022, June 08). *Yesterday, today, and tomorrow of mobile payments*. Peerbits

7 National Payments Corporation of India. (n.d.).

a nation can be digitalised even when its people are unconnected – a notion overlooked by global indices for the following reasons -

- ***Captures a narrow notion of digitalisation.*** The current set of global indices were conceptualised at a time when digitalisation was largely defined by access. The IDI first released in 2009 focuses largely on measuring connectivity. Through its multiple iterations including the latest release, the mandate of ITU has been limited the measurement of the index to focus on connectivity and its related aspects. Similarly, EGDI published biennially since 2001 focuses on e-government development. NRI, launched in 2002 and redesigned in 2019, measures a broader definition of digitalisation.[8] However, it goes beyond the digital realm to include parameters on the quality of life and SDG contribution.

- ***Ignores the network or aggregate effect of digitalisation.*** Global indices measure digitalisation in relative terms, for the average user, say an individual, a business or a government agency, but not at the aggregate (economy-wide) level. For example, EGDI and IDI measure the percentage of population connected to the internet, which at about 52 per cent, places India below the world average of 66 percent, while completely ignoring the fact that India has the second largest number of internet users in the world (over 700 million in 2022).[9] In other words, global indices ignore the scale of the network or breadth of use and focus entirely on the intensity or depth of use by the average member of the network. This explains why Fiji, with nearly 88 percent of its 0.9 million people connected to the internet ranks higher than India with 52 percent of its 1.4 billion people, exposing the inadequacy of the results when scale effects are ignored.[10]

- ***Suffers from double counting***. Global indices often focus on both outcomes and inputs (enablers) of digitalisation. For example, EGDI and NRI both include human capital (i.e., expected years of schooling/adult literacy/ tertiary enrolment) as one of the indicators for measuring digitalisation. Since quality of human capital enables the digitalisation process (one needs to be functionally literate to be able to browse the internet), and since developing countries have lower level of human capital than in developed countries, they get penalised twice, first for low a score on the proportion of internet users and then again for a low score on human capital. Unsurprisingly, global ranking on digitalisation is strongly correlated with country per capita incomes, i.e., developed countries have higher ranks (See Figure 2).

The objective of this report is to propose a new approach to measuring digitalisation. This approach is better suited for developing countries like India that have leapfrogged through stages of digital transformation (See Box 3).

BOX 2

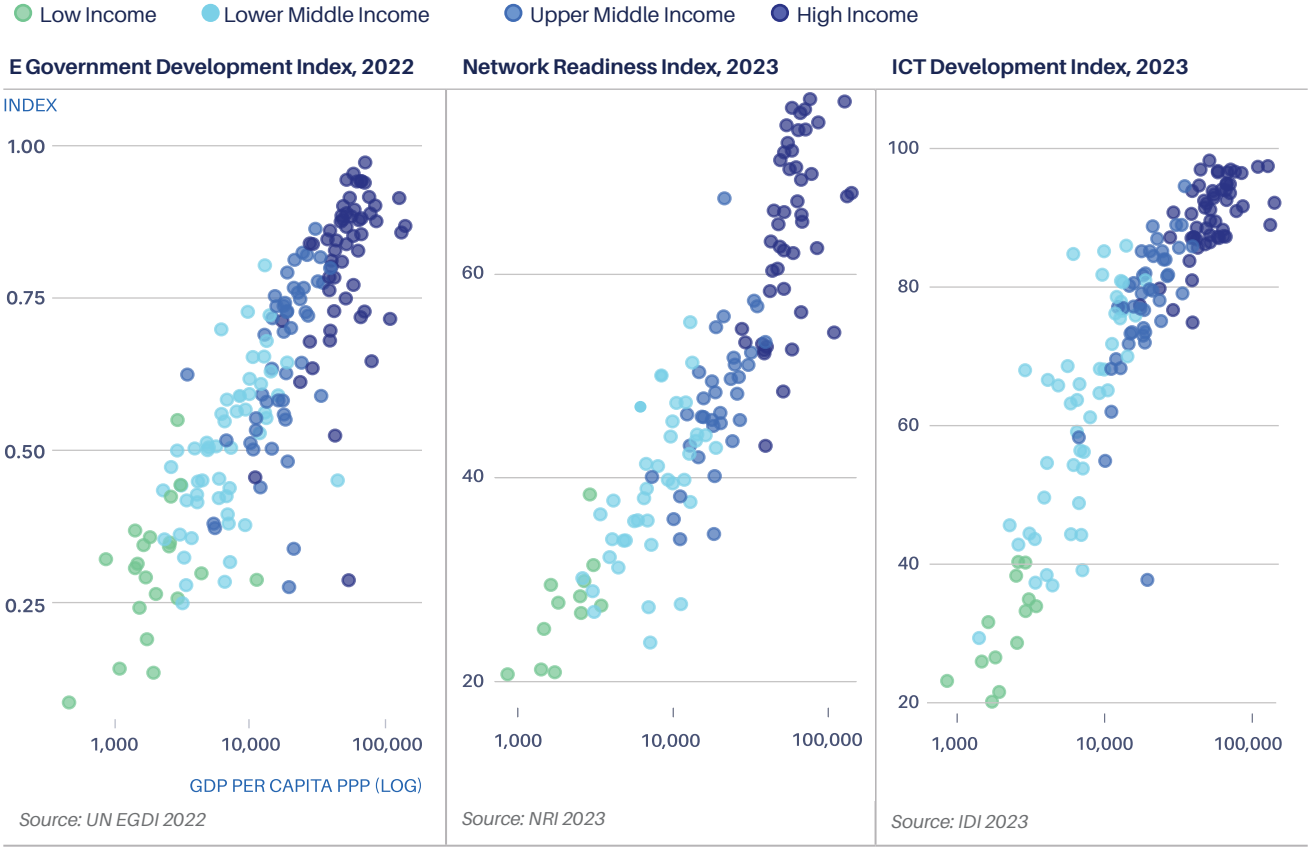
Defining digitalisation: One size does not fit all

While digital technologies have completely transformed our lives, there is no globally agreed definition for many of the terms associated with them. For example, Wikipedia defines digitalisation as the adoption of digital tools to create new or modify existing products, services and operations. According to the Oxford dictionary, digitalisation is to change data into a digital form that can be easily read and processed by a computer. The OECD (2018) refers to digitalisation as the use of digital technologies and data as well as their interconnection that result in new activities or changes in existing ones. For this report, we define digitalisation as the process of adopting digital technologies and data for everyday use, not only to maximise economic and social gains, but also to minimise the risks associated with them.

8 Portulans Institute. *The Network Readiness Index 2022.* (2022, November 15).
9 International Telecommunication Union. (2022). *Measuring digital development: Facts and Figures 2022.*
10 International Telecommunication Union. (2021). Measuring digital development: Facts and Figures 2021

FIGURE 2

Strong and positive correlation between countries' global ranking and their per capita income



Source: UN EGDI 2022

Source: NRI 2023

Source: IDI 2023

BOX 3

Do global rankings matter?

Yes, for a couple of reasons. First, foreign companies, investors and policymakers, who are not familiar with India's digital transformation, often rely on global indices to form opinions and make decisions. For example, G20 foreign delegates were impressed with India's digital payment platform, UPI (Unified Payment Interface), which they tested during their visit to India. However, given India's low ranking, one would not expect digital technologies to be as ubiquitous in the country. Second, an improved reflection of India's digitalisation in global rankings will aid its ability to participate and contribute in global internet fora for standard setting and governance.

The reach of India's home-grown digital payments system impressed G20 foreign delegates

1. G20 Saudi Arabia delegate paying for handicrafts using UPI

Source: Blitz India

2. German Minister for Digital and Transport buying vegetables using UPI

Source: Business Today

Measuring the full spectrum of digitalisation: The CHIPS framework

The Connect-Harness-Innovate-Protect (CHIP) framework was first presented in the SIDE 2023 report to reflect the progress in India's digitalisation vis-à-vis G20 countries. The report presented a series of graphs that were summarised into a subjective assessment of India's overall performance.

While the framework was developed to measure India's progress it can also be applied generally. In this iteration, we have made two main additions. First, we have expanded the CHIP framework by adding a fifth pillar – sustainability of digital infrastructure, updating our framework to CHIPS (see Figure 3). Second, alon-with qualitative discussions we have quantitatively measured the level of digitalisation in G20 countries by aggregating several indicators into a composite index, referred to as the CHIPS score.

FIGURE 3

The CHIPS framework

Source: IPCIDE Research

The CHIPS framework has three tiers: pillars, sub-pillars and indicators. The five pillars – Connect, Harness, Innovate, Protect and Sustain – measure the entire spectrum of digital transformation. The 'Connect' pillar benchmarks internet connectivity from the lens of accessibility, affordability, and quality. The 'Harness' pillar measures how digital technologies are being leveraged through various applications such as e-commerce, digital health, digital learning, digital payments and e-governance services. It also measures the net value added by the ICT sector and services exports.

The third pillar, 'Innovate,' measures start-up activties, and the development and adoption of emerging technologies. The fourth pillar, 'Protect,' measures a country's preparedness against and vulnerability to cybercrimes, and privacy breaches. It includes levels of public trust on online privacy provisions and internet governance. The final pillar 'Sustain,' measures efforts towards building digital economies that are environmentally sustainable.

The five pillars are classified into 16 sub-pillars, and the sub-pillars are further categorised into 50 indicators that measure digital outcomes. Many indicators in our framework overlap with those used in global indices, though we also introduce several new ones (see Box 4). The sub-pillars and indicators together allow for a comprehensive measurement of each pillar (see Figure 4 and Annexure 1 for more details).

Measuring digitalisation: Aggregate vs Average User

The SIDE 2024 report builds on the previous year's report by building two separate sets of indicators: CHIPS (Economy) and CHIPS (User). CHIPS (Economy) measures digitalisation at the aggregate (economy-wide) level, just the way GDP estimates the aggregate output of a country, while CHIPS (User) measures the same at the individual level; the equivalent of per capita GDP. Under both indices, the pillars and sub-pillars remain the same, though the indicators used in CHIPS (User) are appropriately deflated. For example, CHIPS (Economy) is based on the total number of internet users in a country, while CHIPS (User) is based on the number of internet users as a share of population (see Table 1 for few examples).

Extending the framework to the sub-national level

We extend the CHIPS framework to the sub-national level, enabling comparison of the level of digitalisation across 28 Indian states and 8 union territories (UTs). We drop the "Sustain" pillar for which comparable quality indicators across all states and UTs was not available. The four pillars are further sub-divided into 14 sub-pillars and 50 indicators. In this section, we report only the index at the average user level, namely CHIP (User), although it is possible to compute CHIP (Economy)

for states.[11] For reporting purposes, we split the 28 states and 8 union territories into smaller homogenous groupings – UTs and states with a population of less than 10 million are one group while other remaining (relatively larger) states are the second group (see Part 2 and Annexure 3 for more details).This is in line with other sub-national indices such as the States' Start-Up Ranking calculated for India.

TABLE 1

The difference between the two indices is only at the level of the indicators

Indicator	CHIPS (Economy)	CHIPS (User)
Price of mobile data and voice tariff package	Price is adjusted for purchasing power parity	Price is adjusted for purchasing power parity and divided by per capita income
Number of internet users	The absolute number of internet users	The number of internet users as a share of population
ICT service exports	Measures the dollar value of exports	The dollar value of exports as a proportion of the country's GDP
Start-ups	Total market value of unicorns in billion USD	Total market value of unicorns as a proportion of the stock market capitalisation in the country

Source: IPCIDE Research

BOX 4

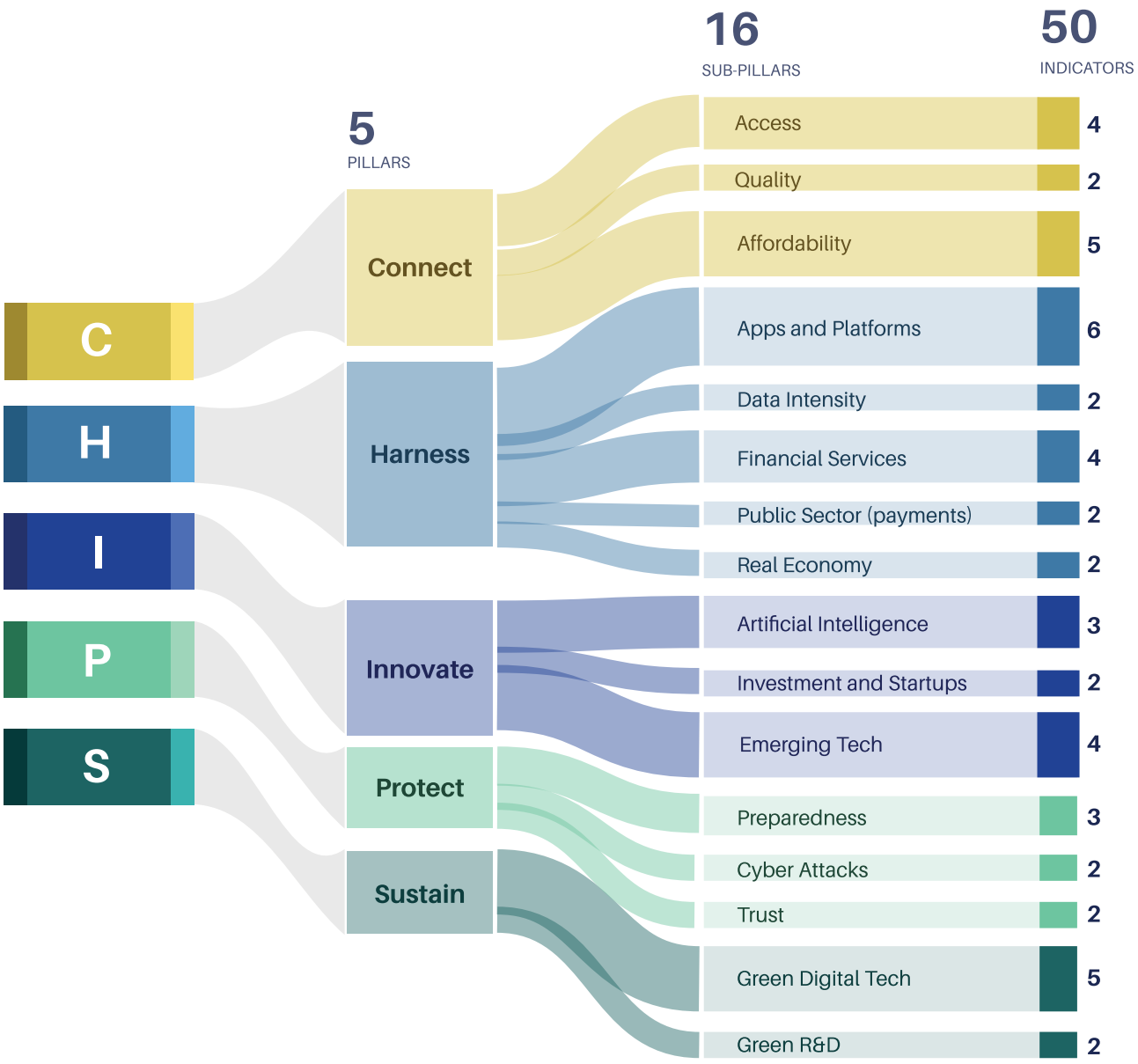
Similarities between the CHIPS index and other global indices

CHIPS was conceptualised differently from other global indices but is derived from a set of indicators that compares well with other global indices. For example, out of the ten indicators used in IDI, four indicators are common to both the IDI and CHIPS, all belonging to the Connect Pillar. With NRI, there are 21 indicators in common that cut across all five pillars of CHIPS - Connect, Harness, Innovate, Protect and Sustain. For details, see Annexure 2.

11 Given the unique nature of the indicators on connectivity, e-governance, business innovation, etc. available for Indian states, sub-national CHIP cannot be compared with cross-country CHIPS. We hope to create sub-national indicators that can be compared with national ones in the SIDE 2025 report, enabling us to compare levels of digitalisation, say in Maharashtra or Orissa with Australia and Japan.

FIGURE 4

Three tiers in the CHIPS framework



Source: IPCIDE Research

PART 1

India and the World

Measuring digitalisation of countries

India is the third largest digitalised country in the world

When compared by their aggregate level of digitalisation, i.e., by CHIPS (Economy), India ranks as the third largest digitalised country in the world, behind US and China, and ahead of UK, Germany and Japan (see Table 2). While US ranks first with a score of 65 and China a close second with 62, India is a distant third with a score of 39, followed by UK (29), Germany (24) and South Korea (22). What is interesting is that three developing countries - China, India and Indonesia, are ahead of Japan, France and Canada – something not reflected in other global indices measuring digitalisation.

India's third rank is derived from outcomes in three of the five pillars. India is ranked second in the Connect pillar and third in both the Harness and Innovate pillars (see Figure 5).[12] CHIPS (Economy), drives up the rank of China and India in the connect and harness pillars largely due to the scale effect. However, for innovate, India measures up on its performance under AI and start-ups. US is in the top 3 for all pillars, except Connect. It has made significant advancements not only in leveraging digital technologies, but also in protecting the ecosystem against the downside risks and in creating a greener digital economy. India on the other hand, fares poorly on the indicators of Protect and Sustain (see Figure 6). From the global perspective, India's performance in digital transformation at the economy level can be grouped into three broad categories (see Figure 7):

TABLE 2

India is the third largest digitalised country in the world

Rank	Country	CHIPS (Economy) Score
1	US	65.1
2	China	62.3
3	**India**	39.1
4	UK	28.8
5	Germany	23.8
6	South Korea	21.9
7	Australia	20.7
8	Indonesia	20.6
9	Japan	20.4
10	France	19.9
11	Canada	19.8
12	Saudi Arabia	19.7
13	Turkey	19.4
14	South Africa	19.4
15	Brazil	18.6
16	Mexico	18.2
17	Italy	17.6
18	Russia	16.5
19	Argentina	14.9

Source: IPCIDE Research

12 In the final calculation of the CHIPS score, both protect and sustain pillars are given half the weights of the other three pillars due to the lack of reliable and comparable data to satisfactorily cover all their key aspects. In future iterations, as more data becomes available, they can be weighted equally as the other pillars. More details on the calculation of the scores are provided in Annexure 1.

FIGURE 5

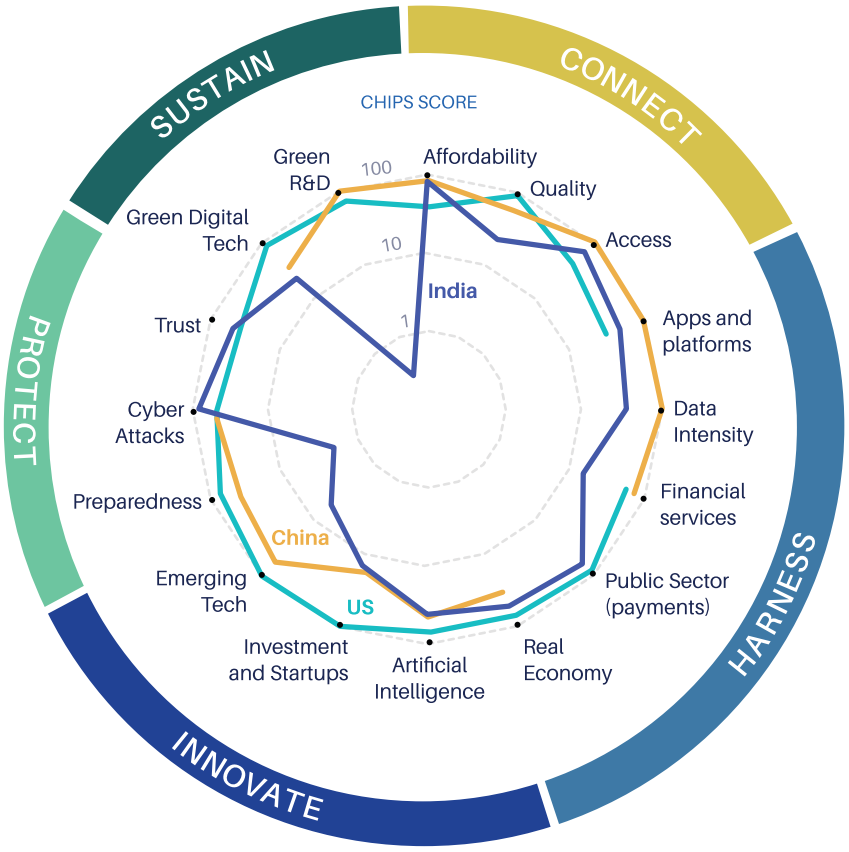
India is ahead of many developed countries in the Connect, Harness and Innovate Pillars

	Overall CHIPS score	Connect	Harness	Innovate	Protect + Sustain
1	US	China	China	US	US
2	China	**India**	US	China	China
3	**India**	UK	**India**	**India**	Germany
4	UK	US	UK	UK	Japan
5	Germany	South Korea	Japan	Germany	Saudi Arabia
6	South Korea	South Africa	Brazil	Japan	UK
7	Australia	Turkey	Russia	Canada	Canada
8	Indonesia	Australia	Germany	France	Australia
9	Japan	Indonesia	France	South Korea	Indonesia
10	France	Russia	Indonesia	Brazil	Mexico
11	Canada	Saudi Arabia	S Korea	Australia	France
12	Saudi Arabia	France	Canada	Russia	**India**
13	Turkey	Germany	Mexico	Italy	Turkey
14	South Africa	Mexico	Italy	Indonesia	South Africa
15	Brazil	Brazil	South Africa	Mexico	Italy
16	Mexico	Italy	Turkey	Turkey	South Korea
17	Italy	Canada	Australia	Saudi Arabia	Argentina
18	Russia	Argentina	Saudi Arabia	Argentina	Brazil
19	Argentina	Japan	Argentina	South Africa	Russia

Source: IPCIDE Research

FIGURE 6

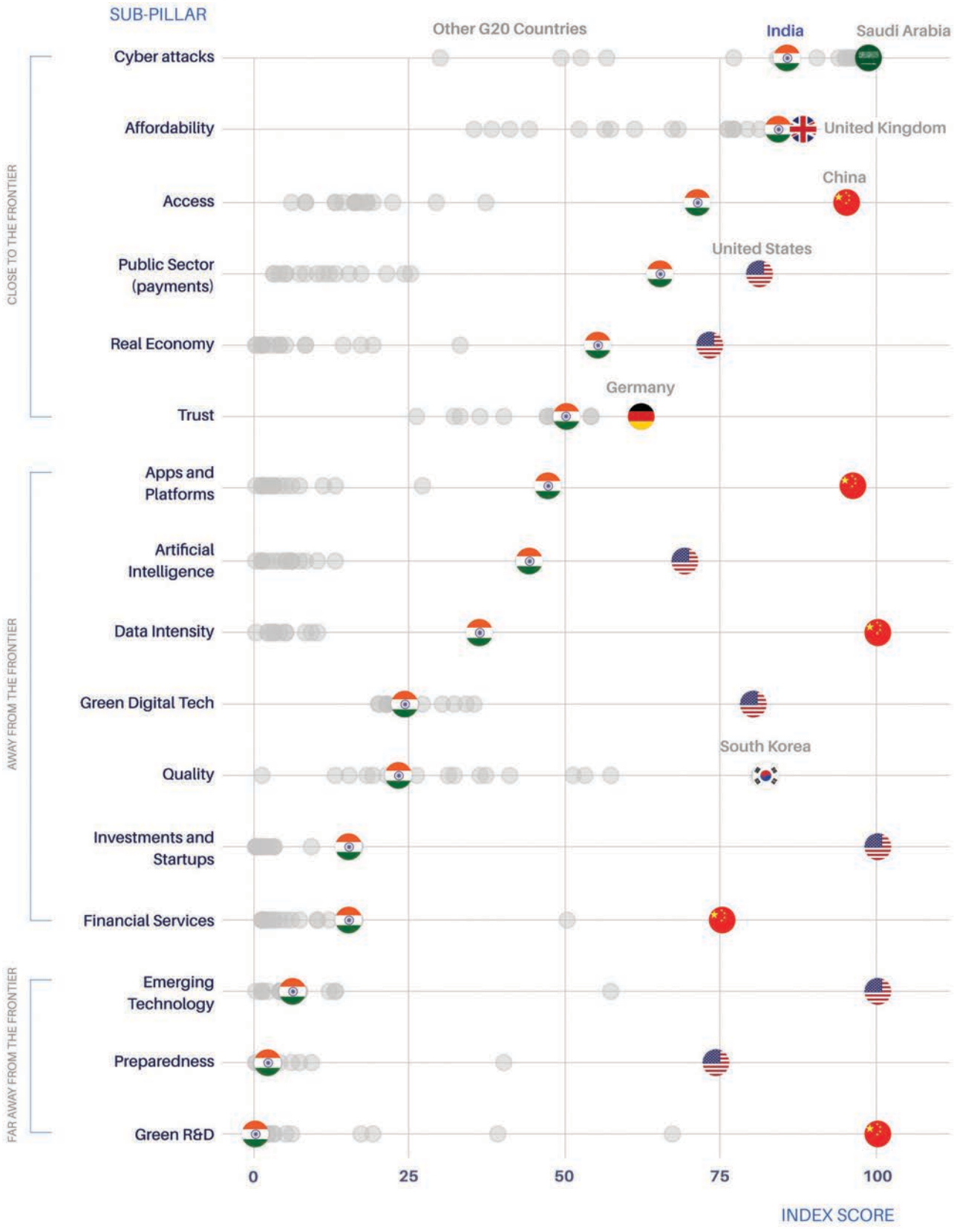
India's performance on CHIPS indicators as compared to the US and China



Source: IPCIDE Research

FIGURE 7

India vis-à-vis the global frontier



Source: IPCIDE Research

- At the global frontier – six sub pillars – (cyber attacks, affordability, access, public sector(payments), real economy and trust)
- Moderate distance from the frontier - seven sub-pillars (apps and platforms, AI, green digital tech, data intensity, quality, investments and start-ups and financial services).
- Far away from the frontier - three sub pillars (emerging technology, preparedness and green R&D).

Operating at the global frontier

The real economy sub-pillar, comprising ICT services exports and ICT value added have been well-established sectoral growth stories since the 1990s.[13] India has maintained its comparative advantage in ICT services and is the recognised powerhouse for off-shore business services.[14] In a sense, the ICT industry laid the groundwork for India's digital transformation as we see it today.

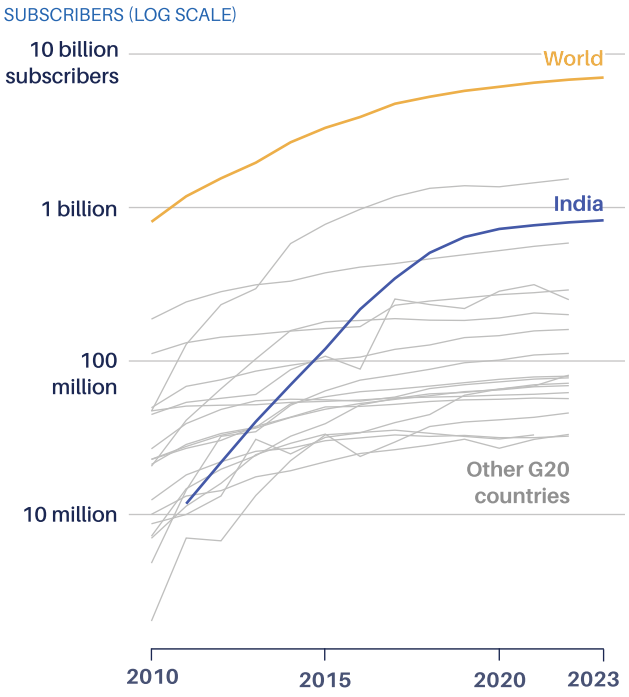
In several areas, India not only has the advantage of scale, but also of rapid growth. For example, India has the second highest mobile and internet users as well as one of the fastest growth rates in the world (see Figure 8). Business connectivity to the internet is also relatively high in India, although it has not been captured in the index due to missing contemporary data for several countries. These issues are further discussed in the next section of the report.

India is also the market with the cheapest smartphones and data plans among G20 countries. For Indian telecom operators' the average revenue per user (ARPU) ranges from Rs. 140 – 200, compared global range of Rs.600 to Rs.850.[15] The current range is lower than what telcos need to become profitable and invest in infrastructure upgradation. However, given low disposable incomes, scaling up means that services have to continue to remain affordable. A bigger challenge is affordability of internet-enabled devices. While advances in technology have brought down the average smartphone price, even the cheapest smartphones are not always affordable for the average Indian. According to A4AI, the cheapest smartphone available in India is priced at Rs. 4,999, which is about 2.5 percent of annual per capita income in 2022-23.[16,17] For the bottom 50 percent of the population, it is on average a little more than a whole month's income. According to IDC's smartphone shipment data for the third quarter of 2023, the market share of entry level smartphones increased by 16 per cent YoY, supported by a series of vendor-led affordability efforts including microfinance schemes.

FIGURE 8

India is one of the fastest growing mobile internet networks in the world

Number of Active Mobile Broadband Subscriptions



Source: ITU and TRAI
Note: India's 2023 value is the number of broadband mobile wireless subscribers as of June 2023 from the TRAI Performance Indicator report April-June 2023.

13 Erumban, A., & Das, D. K. (2016). Information and Communication Technology and Economic Growth in India. *Telecommunications Policy, 40(5), 412-431)*
14 S Sun, H., Henry-Nickie, M., & Frimpong, K. (2019, March 29). *Trends in the Information Technology sector.* Brookings
15 Govt wants India's telecom service to remain most affordable in entire world: Telecom Minister Ashwini Vaishnaw. (2023, 10 29). Times of India. Retrieved 01 24, 2024 Press Trust of India. (2023, October 29). *Govt wants India's telecom service to remain most affordable in entire world: Telecom Minister.* The Hindu Business Line
16 Press Information Bureau. (2023, August 02). *Per Capita Income.* Ministry of Statistics & Programme Implementation
17 The Alliance for Affordable Internet (A4AI). (2021, October 07). Device Pricing 2021.

But the inflationary stress is likely to limit market growth in the future.[18]

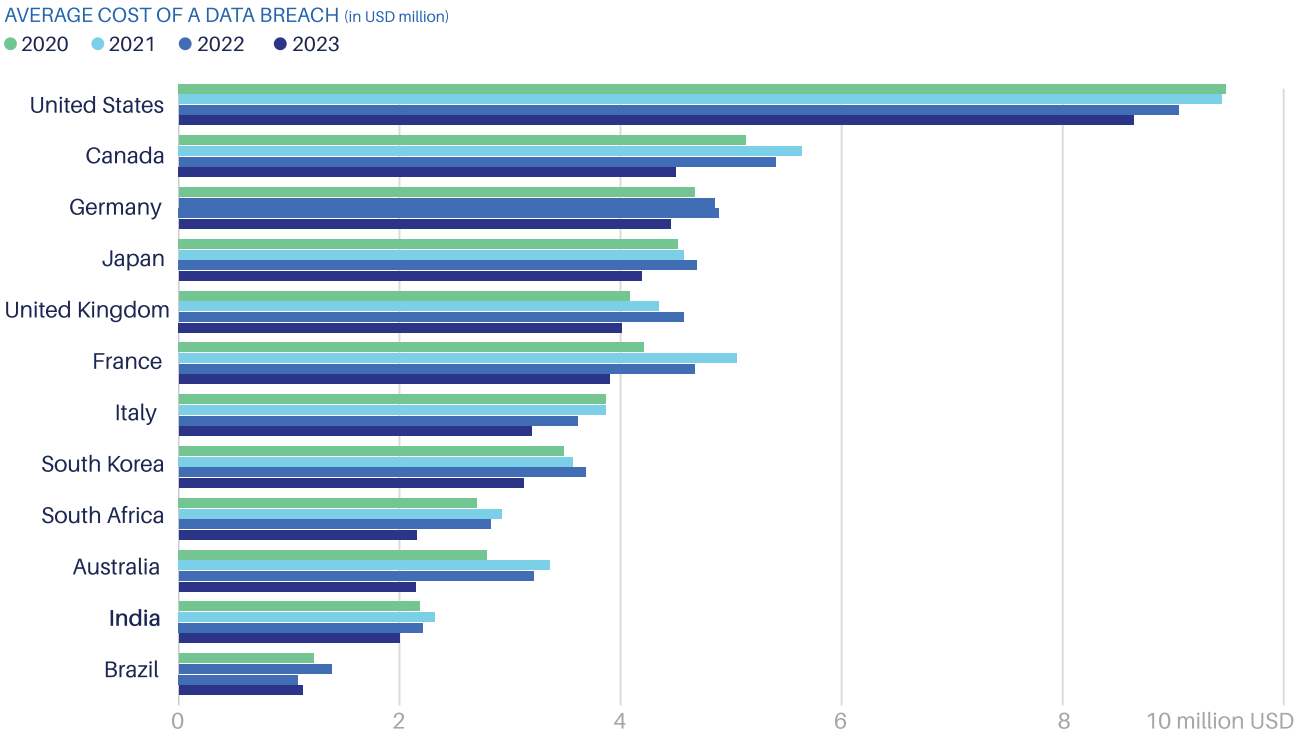
India has made remarkable progress on the use of digital payments, especially in the public sector. Data from the World Bank's Findex Survey shows that digitally delivered government transfers or pensions increased to 10 per cent of the population, amounting to about 100 million people in 2021.This accounts for almost 55 percent of government transfer or pension recipients. The proportion of public sector wage recipients receiving payments directly into their account also increased from 63 per cent in 2017 to 73 per cent in 2021, the highest increase among G20 countries during this period, albeit for a relatively low base.

Although Indians experience fewer cyberattacks compared compared to their peers in other G20 countries, the scale of its online base means that even if a small share of users are targets of cyberattacks, the overall number of incidents will be high. There was an average of over 9 million email leaks per quarter between mid-2020 and mid-2023. The estimated average cost of a data breach, while relatively low, has been increasing, except for 2023 when most countries saw a decline from the previous year (See Figure 9).

Online trust is comparatively high in India relative to most G20 countries. The online trust indicators are compiled from surveys carried out by CIGI and IPSOS which consistently finds Indian users trusting the internet (89 percent in 2019 and 79 percent in 2022), the second highest number after Germany. Online trust is a multi-dimensional issue that is affected not only by the

FIGURE 9

Cost of a Data Breach



Source: IBM Cost of a Data Breach report 2023, 2021
Note: The estimated cost is the average per data breach incident. It is based on results from 537 organizations across 17 countries and regions, and 17 industries. While sample sizes in some countries, regions and industries are small, organizations surveyed are chosen to be representative

18 IDC Tracker. (2023). Worldwide Quarterly Mobile Phone Tracker. IDC Corporate.

diffusion of the internet, but also policies to govern it, incidence of threats and user perceptions and awareness that transcend traditional economic policy. It is possible that trusting the internet more than counterparts in other G20 countries contributed to the faster adoption of digital technologies in India.

Moderate distance from the global frontier

Indicators for which India is at a moderate distance from the frontier have increased significantly in the last few years and are also the ones with high potential. The rise in e-commerce being a case in point, which is expected to see a 40 percent year on year growth in 2023 to an estimated size of USD 110 billion.[19] An estimated 1.5 – 2.5 million MSMEs are already selling online, this is also expected to double by 2027. The rising share of e-commerce in Tier 2 and Tier 3 cities reflects the mass-scaling of e-commerce in India.[20]

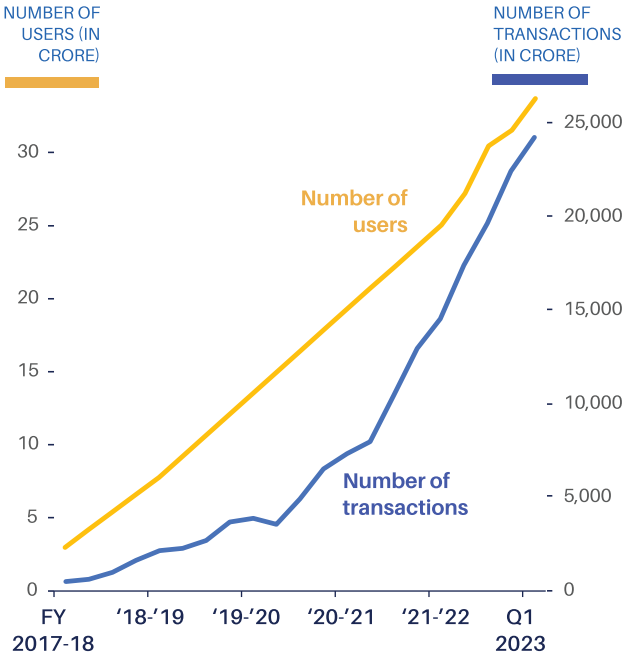
India is second on the AI sub-pillar. As the current Chair of the Global Partnership on Artificial Intelligence (GPAI), India is playing its part by supporting the development of several projects and use cases, while emphasising the safe, secure and trustworthy application of the technology.[21] India's biggest technology companies are yet to join the AI race in a big way. However, with India's enormous engineering talent and policy push, its role in global AI development will only expand over time.

While India's advancement on fintech has been impressive, balancing innovation with regulation remains a work-in-progress. India has the second highest number of digital payments users in the world and the highest number of digital transactions. However, the number of users is increasing at a pace much slower pace than the volume of digital transactions in India (see Figure 10).

The growth of Indian fintech is not only in the realm of digital payments but also alternative lending platforms and banking tech.[22,23] Most of this expansion, however, is happening only in urban India. Neo-banking serves as a perfect example.[24] Even though RBI has adopted the innovation sandbox, undefined regulations have created several regulatory grey area innovations.[25] Fintech players not only deal with constant changes in technology, but also an array of regulations and compliances. For RBI, the balancing act of supporting innovation and guarding against emerging risks of cyber fraud remains a challenge.

FIGURE 10

UPI Diffusion in India



Source: NPCI, https://pib.gov.in/PressReleasePage.aspx?PRID=1897272 https://pib.gov.in/FeaturesDeatils.aspx?NoteId=151350&ModuleId%20=%202

Note: Cumulative number of unique UPI users are of March of each year, corresponding to the end of each financial year denoted on the x-axis.

19 NASSCOM. (2023). Priming for a *No Normal Future. Technology Sector in India 2023: Strategic Review.*

20 Banthia, J. (2023, December 28). *2023 Year in Review| Tier 2, Tier 3 cities fuel growth for e-commerce firms.* The Hindu Business Line.

21 Bhatia, R. (2023, December 16). *New Delhi summit on Artificial Intelligence, a quest for international collaboration.* WION.

22 Gadia, J. P. (2022, December 31). *What are the technology trends as a catalyst for digital lending innovation?* LiveMint

23 DBS. (2023, June 05). *Digitalization in Banking: Upcoming Trends.*

24 Dubey, N. (2022, December 29). *Know all about neobanks before opening an account.* LiveMint

25 Innovations that are new and need updated regulations to ensure stability to both - users and businesses.

Far away from the frontier

While India ranks third in the Innovate pillar, the frontier analysis shows that there is considerable scope to boost performance in other emerging technologies, particularly in terms of their commercialisation. The policy push behind technologies such as AR, VR and IoT is much lower when compared to AI. As Gartner's Hype Cycle would suggest, many of these technologies are in the innovation trigger phase and are likely to be adopted only by 'innovators' in the country.[26] Scaling these technologies will be a function of widely applicable use cases and their affordability. On preparedness, the country's Cyber Security Policy was las updated in 2013, much before the Digital India and AI Strategies were announced. This is now overdue - a strategic focus on cyber security preparedness is important given the rising number of attacks in India. According to Cyble, India along with US, are the most targeted countries globally.[27] The report also states that Law Enforcement Agencies, and Banking, Financial Services and Insurance are the most targeted sectors in India.

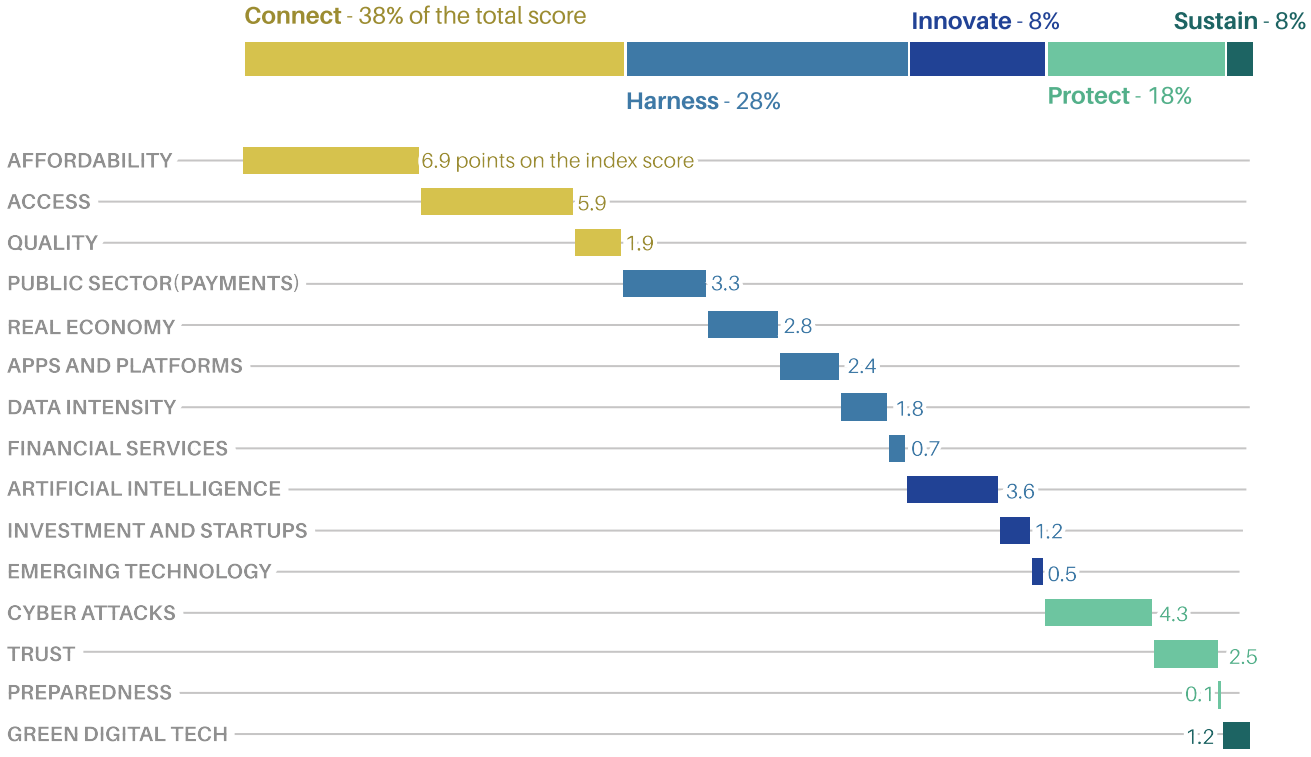
India emerging as the third digital pole

In conclusion, India's third rank in CHIPS (Economy) is driven by two scale-driven pillars, Connect and Harness, that collectively contribute 66 per cent to India's total score (see Figure 11). This high performance is however, not without threats of potential cyberattacks, high digital divides- both regional and gender, incomplete governance and oversight mechanisms, and fragile analogue complements such as power infrastructure and literacy levels.

At the global level, the digital landscape seems to be gravitating towards three poles: US, China and India (see Figure 12). With a large population (330

FIGURE 11

India's high CHIPS score is driven by two scale driven pillars, Connect and Harness



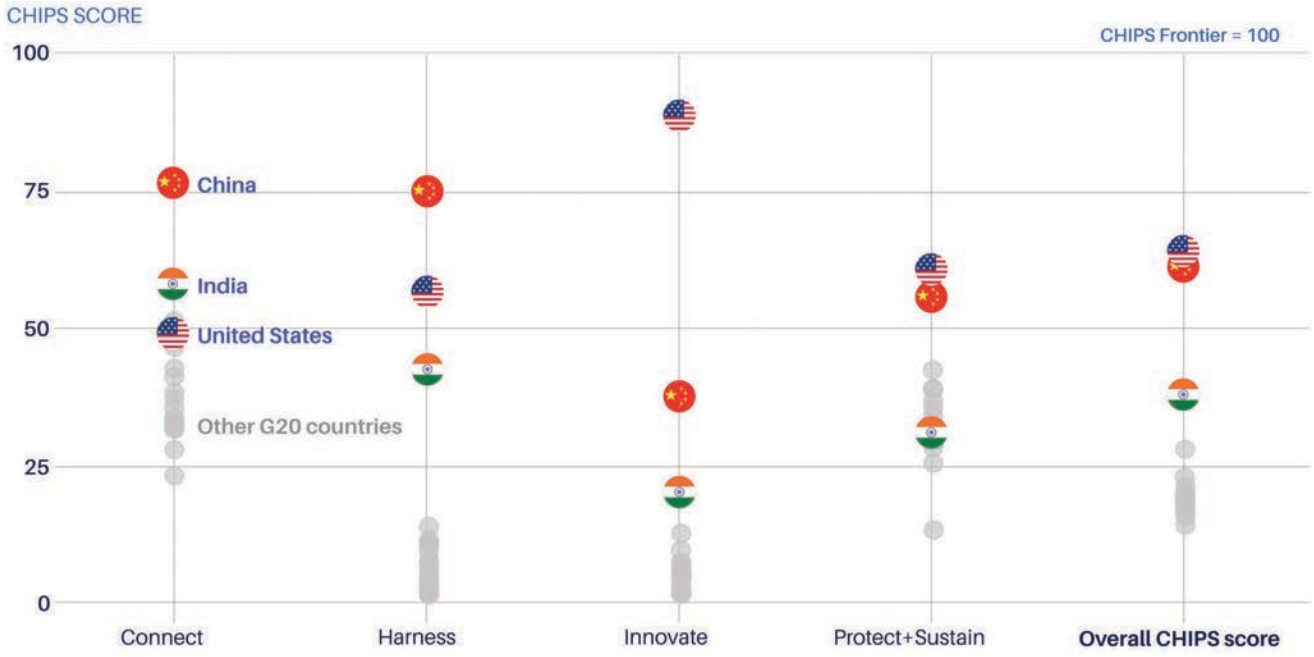
Source: IPCIDE Research

26 Gartner. (n.d.). Gartner Hype Cycle.
27 Cyble. (2023). Threat Landscape Report 2023-24.

million) and high per capita income ($60,000), the US will continue to remain the most digitalised country in the world for the foreseeable future. China has the scale (1.4 billion people) and relatively high per capita income ($18,000), but significantly trails the US in the innovation pillar. India has scale (1.4 billion people) but is disadvantaged by its low per capita income (only $2,700). The good news for India is that the CHIPS (Economy) score is strongly correlated to the size of the economy (see Figure 13). Therefore, as long as India is able to demonstrate its ability to provide scalable low-cost solutions through the use of digital public nfrastructure (DPIs), it will remain a case study for many low- and middle-income countries to emulate (see the spotlight section of the report). And in the medium-term, if India maintains its current status as the fastest growing economy in the world, it will be in a good position to close the gap with US and China.

FIGURE 12

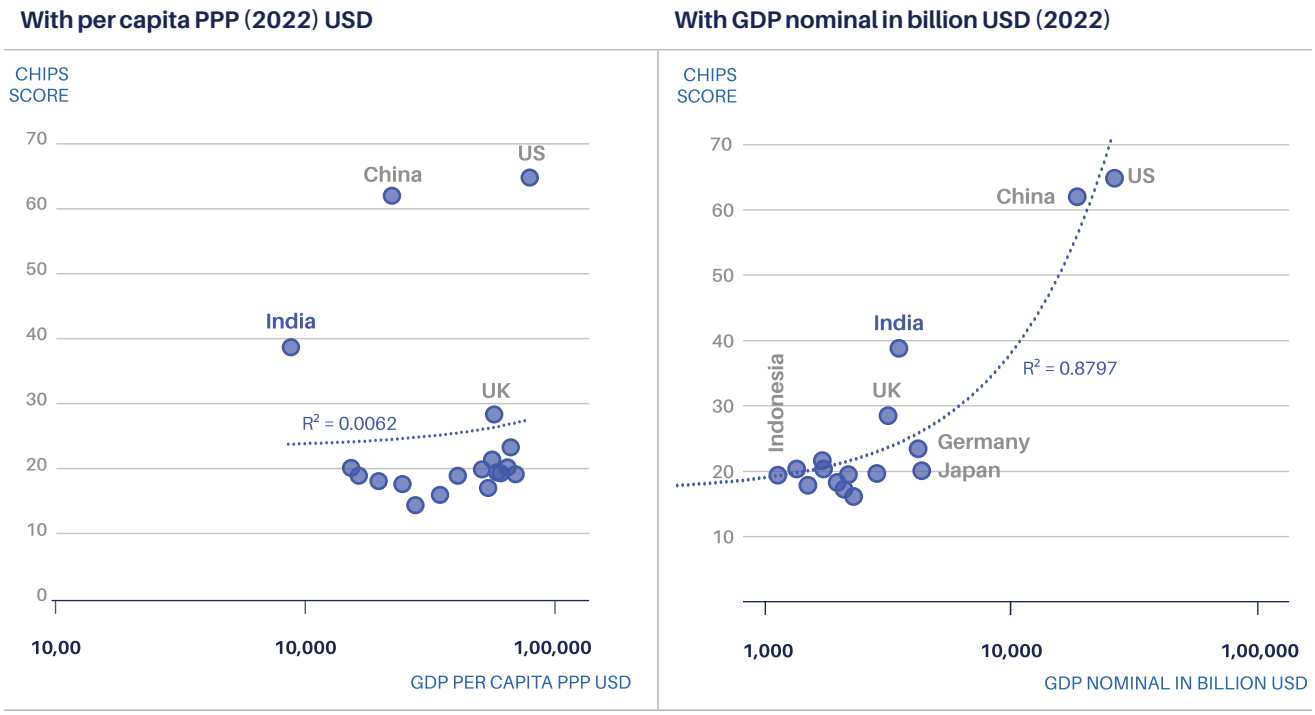
India as an emerging third pole in the world's digital landscape



Source: IPCIDE Research

FIGURE 13

As expected, CHIPS (Economy) score is uncorrelated with per capita income but is strongly linked to the scale or size of the economy



Source: IPCIDE Research and World Economic Outlook

Measuring digitalisation at the level of users

Highly digitalised nation, moderately digitalised users

While India as a nation is highly digitalised, the average Indian is not. This explains why India is ranked 12th among the G20 countries in terms of level of digitalisation of the user, i.e., by CHIPS (User) score, as shown in Table 3. This is not entirely unexpected, as per capita income is positively and strongly correlated with the consumption of digital goods and services, and India is the poorest country in the G20. But even by this criterion, India's score is higher than all G20 developing countries except China and Argentina, and is ranked above Italy, a G7 country. A comparison of CHIPS ranking by Economy and User is instructive. As shown in Figure 14, there is a positive correlation between the two. The deviation from the trend is significantly high for many developing countries like China, India and Indonesia, who rank high on CHIPS (Economy) due to their large scale, but relatively low on CHIPS (User) because of low per capita income. Interestingly, India is ranked higher than seven of the G20 countries on both Economy and User, including Russia and Italy. This is different from what one would find in other global indices. For example, in the EGDI, five of these seven countries are ranked higher than India. Similarly, in the NRI, four of these seven countries are placed above India (see Annexure 4 for a comparison of ranks for G20 countries from NRI, IDI and CHIPS).

India's performance for CHIPS (User)

India's score for CHIPS (User) varies considerably across pillars. It is placed at the very bottom in the Connect and Harness pillars, 4th in Innovate and 13th in Protect plus Sustain (see Figure 15). The scale effect boosting India's position in the Connect pillar for CHIPS (Economy), has been reversed. For CHIPS (User), India's score is dominated by the Innovate pillar, which contributes almost 30 per cent, followed by Harness at 27 per cent (see Figure 16).

TABLE 3

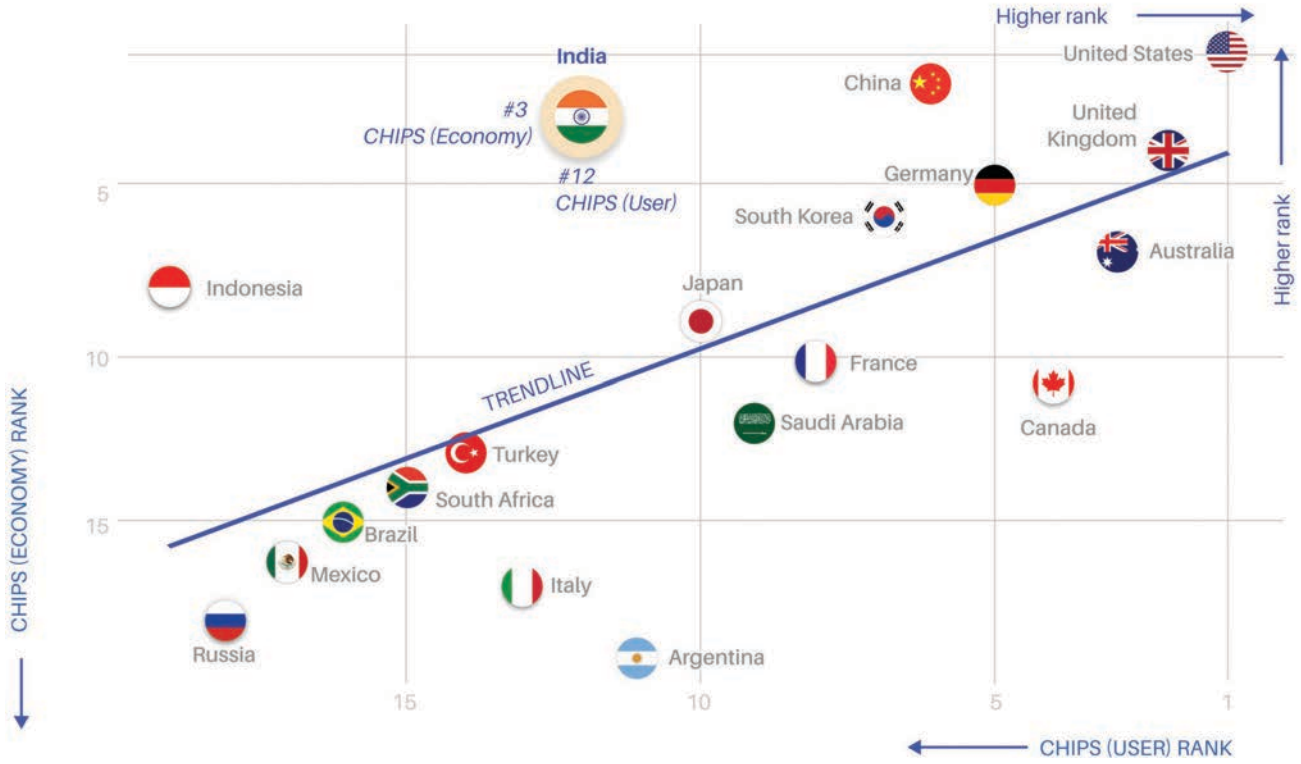
India is ranked 12th among the G20 for CHIPS (User)

Rank	Country	CHIPS (User) Score
1	US	64.6
2	UK	57.7
3	Australia	55.8
4	Canada	54.1
5	Germany	50.8
6	China	50.3
7	South Korea	49.7
8	France	46.4
9	Saudi Arabia	46.1
10	Japan	41.6
11	Argentina	40.9
12	**India**	39.4
13	Italy	39.0
14	Turkey	37.9
15	South Africa	35.7
16	Brazil	35.6
17	Mexico	32.6
18	Russia	32.6
19	Indonesia	30.6

Source: IPCIDE Research

FIGURE 14

CHIPS (Economy) and CHIPS (User) are positively correlated



Source: IPCIDE Research

FIGURE 15

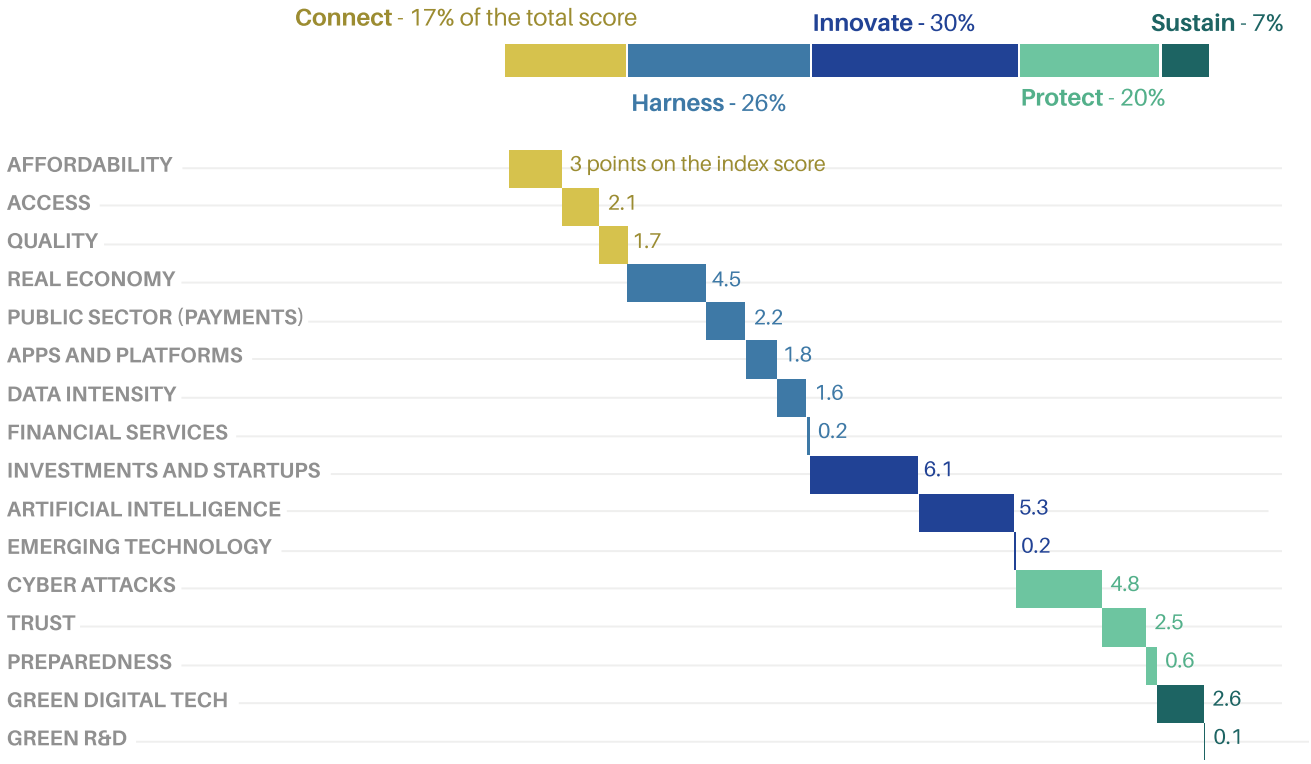
India's score across pillars for CHIPS (User) is highly dispersed

	CHIPS (User) Overall score	Connect	Harness	Innovate	Protect + Sustain
1	US	US	UK	US	Germany
2	UK	China	US	Australia	UK
3	Australia	South Korea	South Korea	UK	Canada
4	Canada	France	Canada	**India**	Argentina
5	Germany	Saudi Arabia	Australia	Canada	Saudi Arabia
6	China	Australia	France	China	Australia
7	South Korea	Canada	Japan	South Korea	US
8	France	Germany	Italy	Germany	Japan
9	Saudi Arabia	UK	Argentina	Turkey	Mexico
10	Japan	Italy	Saudi Arabia	Indonesia	South Africa
11	Argentina	Japan	South Africa	Argentina	Brazil
12	**India**	Russia	Germany	France	China
13	Italy	Turkey	China	Saudi Arabia	**India**
14	Turkey	Argentina	Brazil	Mexico	Turkey
15	South Africa	Brazil	**India**	Japan	France
16	Brazil	South Africa	Russia	Italy	Indonesia
17	Mexico	Mexico	Turkey	Russia	Italy
18	Russia	Indonesia	Indonesia	Brazil	South Korea
19	Indonesia	**India**	Mexico	South Africa	Russia

Source: IPCIDE Research

FIGURE 16

The relative ranking of India is pushed up by the Innovate pillar and dragged down by the Connect pillar



Source: IPCIDE Research

Innovate accounts for nearly one-third of India's CHIPS user score. followed by Harness, Connect and Protect plus Sustain pillars. Within Innovate, the two biggest contributing sub-pillars are AI and start-ups. The fact that India is doing well in the production of newer technologies (such as AI) but lags behind in the adoption of older basic technologies (such as broadband and internet) is a reflection of its own intrinsic duality: the second highest IT services exporter in the world with the largest unconnected population.

Connect: Digital divide remains large but declining

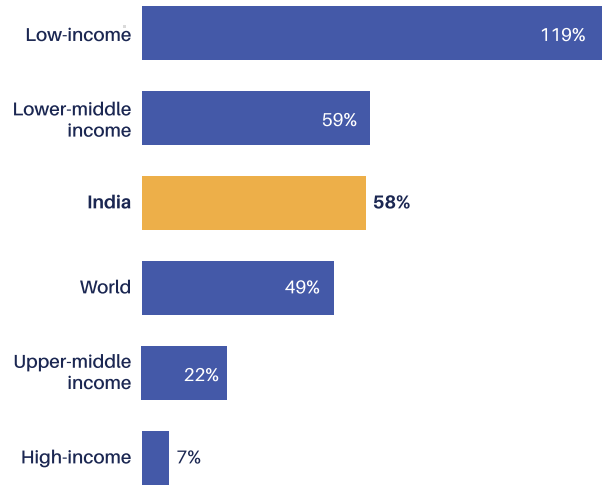
While India has the largest number of users, it also has the largest number of unconnected people. Nearly 48 percent of Indians do not access the internet and the quality of fixed line internet services does not match up to other G20 countries. The unconnected are those on the margins (women, rural population, disabled, the aged and children). The gaps in internet access between rural and urban areas, and between men and women continue to exist (see Figure 17). While these digital divides are large, they are declining. An increase in internet users among rural women between 2020 and 2022, narrowed the gender divide (see Box 5).

India has also done reasonably well in connecting its businesses - 89 percent as of 2022, which is almost on par with developed countries like France and Canada (see Figure 18).

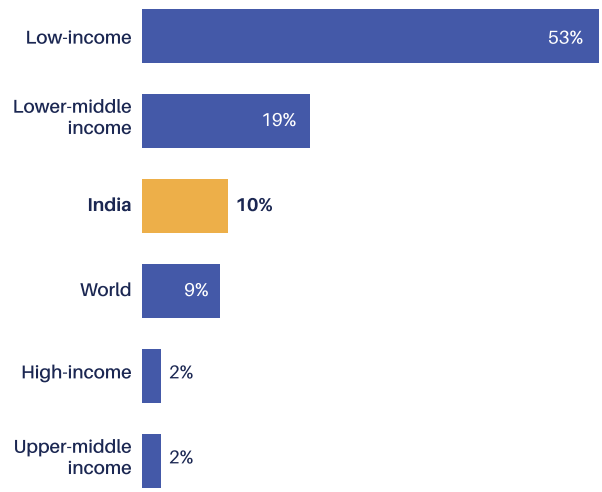
FIGURE 17

Digital Divides in India

Urban-Rural Gap



Gender Gap



Source: ITU, IMRB Kantar ICube

Notes: (i) Urban-Rural gap has been calculated as the difference between the urban and rural penetration rates, divided by the overall penetration rate; (ii) Note: Gender gap has been calculated as the difference between the male and female penetration rates, divided by the overall penetration rate.

BOX 5

Narrowing of India's gender gap between 2020-2022

The gender gap in internet access in India narrowed between 2020 and 2022 with significant improvements in access for rural women. The highest growth appears to be for the 35+ age group, and from the North and East regions, perhaps due to greater sharing of devices by women in households where men tended to be the primary users. However, the fall in gender gap in rural areas varied significantly across the country with some states like Jharkhand recording an increase. Uttar Pradesh and Madhya Pradesh, two states with relatively low rural female access, saw large reductions in the gender gap (see Part 2 for more discussion on sub-national digitalisation).

Source: IPCIDE Research and Kantar IMRB ICube Survey

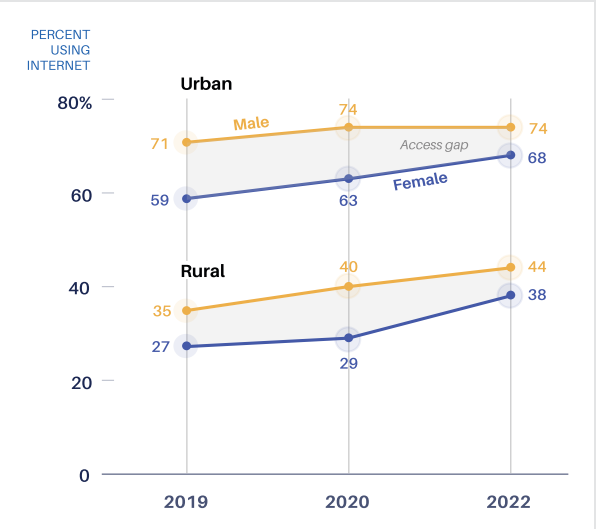
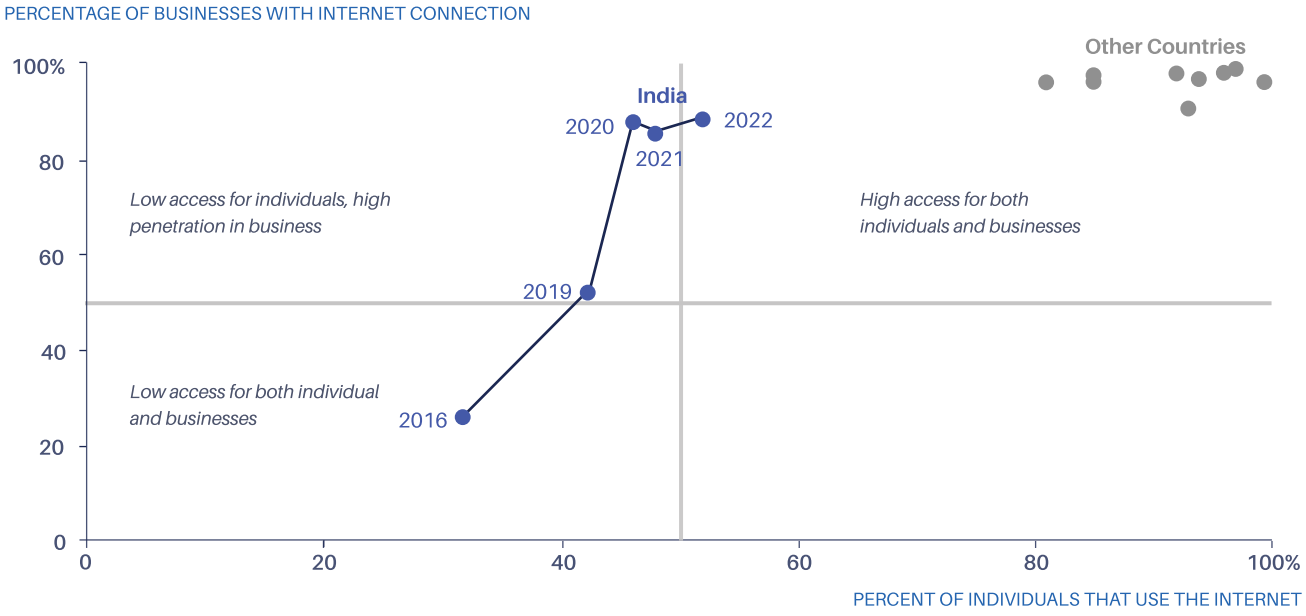


FIGURE 18

While most businesses are connected to the internet, many individuals are not



Source: Compiled from OECD Statistics and IMRB ITOPS Survey
Note: Data is from 2022, and 2021 where 2022 data is not available. ⁎Business internet connectivity data for these countries is for 2021 ⁎⁎ India's business value differs slightly in that it measures any internet connection and not only those with broadband connections, and the sample is all businesses with a fixed premise outside the household. This may leave out many informal firms. The rest of the indicators measure businesses with a broadband connection (both fixed and mobile) (all businesses with 10 or more employed).

While quality indicators are unchanged from CHIPS (Economy), other sub-pillars of Connect such as affordability have worsened when measured as a share of per capita income. Moreover, while India has one of the cheapest smartphones in the world, as a percentage of users' income, it is less affordable than even in the US and UK.[28] Additionally, current data costs in India, while lower than the Broadband Commision's Affordability Target, are higher than the G20 average (see Figure 19).

Harness: Rapid progress in India, but also in other G20 countries

The ranks for all the Harness sub-pillars, with the exception of real economy, which includes ICT value-addition and ICT services exports, are reversed when compared to CHIP (Economy). When normalised by the number of internet users, the rank for apps and platforms drops to 16 as compared to 2 in CHIPS (Economy). However, this does not mean that the addition in number of users for different categories of online services has declined. On the contrary, the absolute addition in users for online learning between 2021 and 2023 was the highest following China, during the same period (see Figure 20).

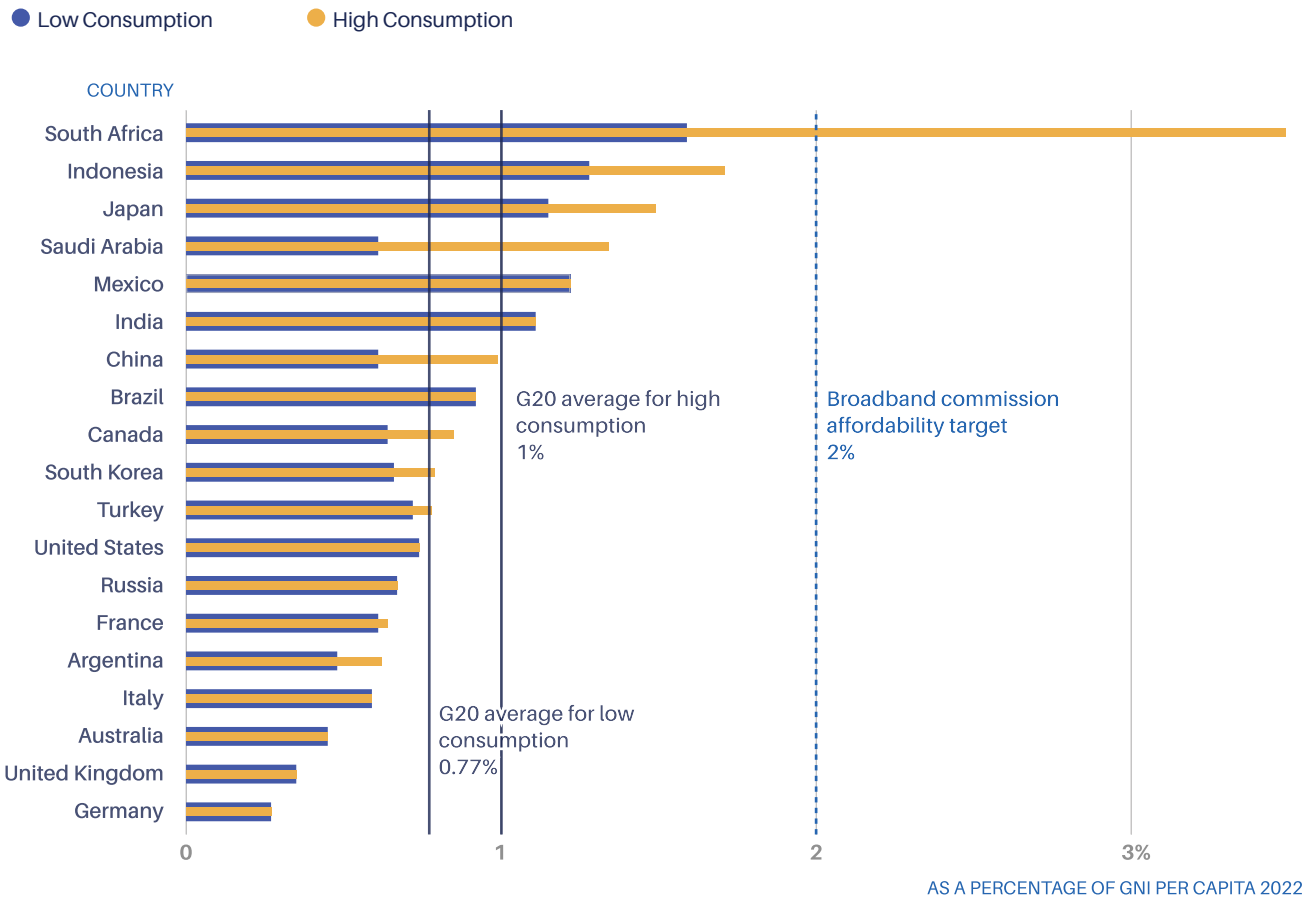
Businesses have also seen a rise in the adoption of digital technologies. The number of businesses with websites has increased across all categories between 2021 and 2022, with the sharpest jump for large industries.[29] In comparison to other G20 countries, this level of adoption is still considerably low, especially for small and medium businesses (see Figure 21). For other digital tools like corporate email IDs and social media presence, the adoption by Indian businesses has improved from 41 per cent and 35 per cent, respectively to 49 per cent. WhatsApp seems to be the main communication tool amongst firms having 1-10 employees and 11 to

28 The Alliance for Affordable Internet (A4AI). (2021, October 07). *Device Pricing 2021*.
29 OECD defines small as < 50 employees, medium as 50 – 250 employees and large > 250 employees

FIGURE 19

Affordability of Data

Mobile Data and Voice Basket



Source: ITU Price Baskets (2022)

Low consumption basket is based on monthly data usage of a minimum of 500 MB of data, 70 voice minutes, and 20 SMSs, and for high consumption on a minimum of 2 GB, 140 minutes, and 70 SMSs. The minimum speed for a broadband connection is 256 kbit/s and is of 3G technologies or above. The data-and-voice price basket is chosen without regard to the plan's modality, while at the same time, early termination fees for post-paid plans with annual or longer commitment periods are also taken into consideration.

100 employee enterprises with 73 per cent and 75 per cent as opposed to 45 per cent and 56 per cent usage of corporate email ids. Most importantly online marketing and selling have also increased year on year, increased year-on-year, and commensurately, across all sizes of firms (see Figure 22). Almost 65 per cent of all manufacturing and services firms are now selling online in India.[30] The results of World Bank's Technology Adoption Survey for India shows that firms are most likely to use technology for payments, followed by sales, and much less likely for quality control, sourcing, production planning and business administration.[31]

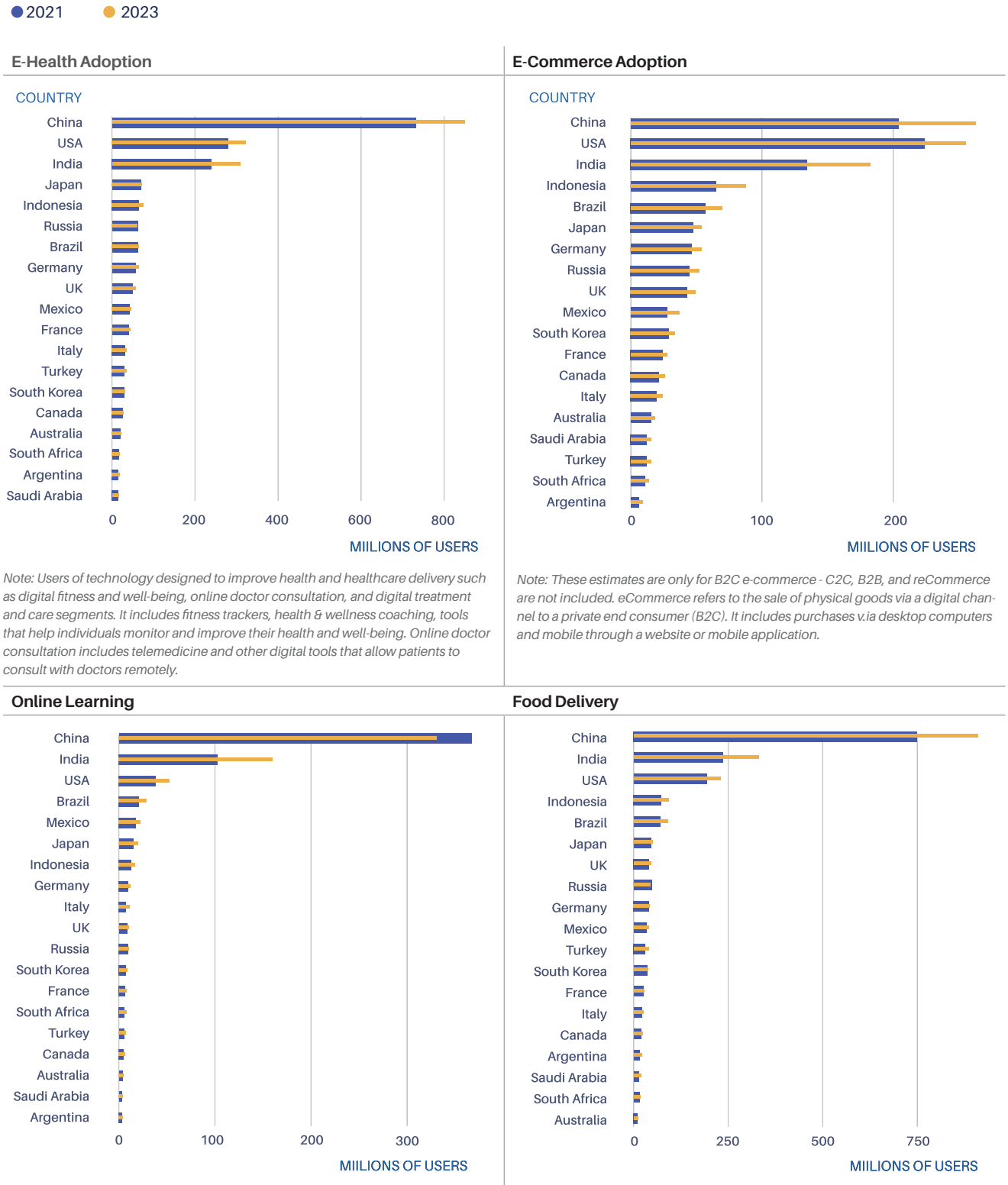
A survey conducted by DBS and Financial Times (FT) Longitude also highlights supply chain procurement, sales and marketing as areas with further potential to be digitized. As per the survey, while the top 20 per cent firms lie close to the global frontier in terms of technology sophistication, the average firm lags.

30 IMRB ITOPS Survey 2022

31 The survey collects data from formal firms from 11 countries, including Bangladesh, Brazil (only the state of Ceará), Burkina Faso, Ghana, India (only the states of Tamil Nadu and Uttar Pradesh), Kenya, the Republic of Korea, Malawi, Poland, Senegal, and Vietnam. Sengal also includes informal firms.

FIGURE 20

Increase in adoption of online services



Note: Users of technology designed to improve health and healthcare delivery such as digital fitness and well-being, online doctor consultation, and digital treatment and care segments. It includes fitness trackers, health & wellness coaching, tools that help individuals monitor and improve their health and well-being. Online doctor consultation includes telemedicine and other digital tools that allow patients to consult with doctors remotely.

Note: These estimates are only for B2C e-commerce - C2C, B2B, and reCommerce are not included. eCommerce refers to the sale of physical goods via a digital channel to a private end consumer (B2C). It includes purchases v.ia desktop computers and mobile through a website or mobile application.

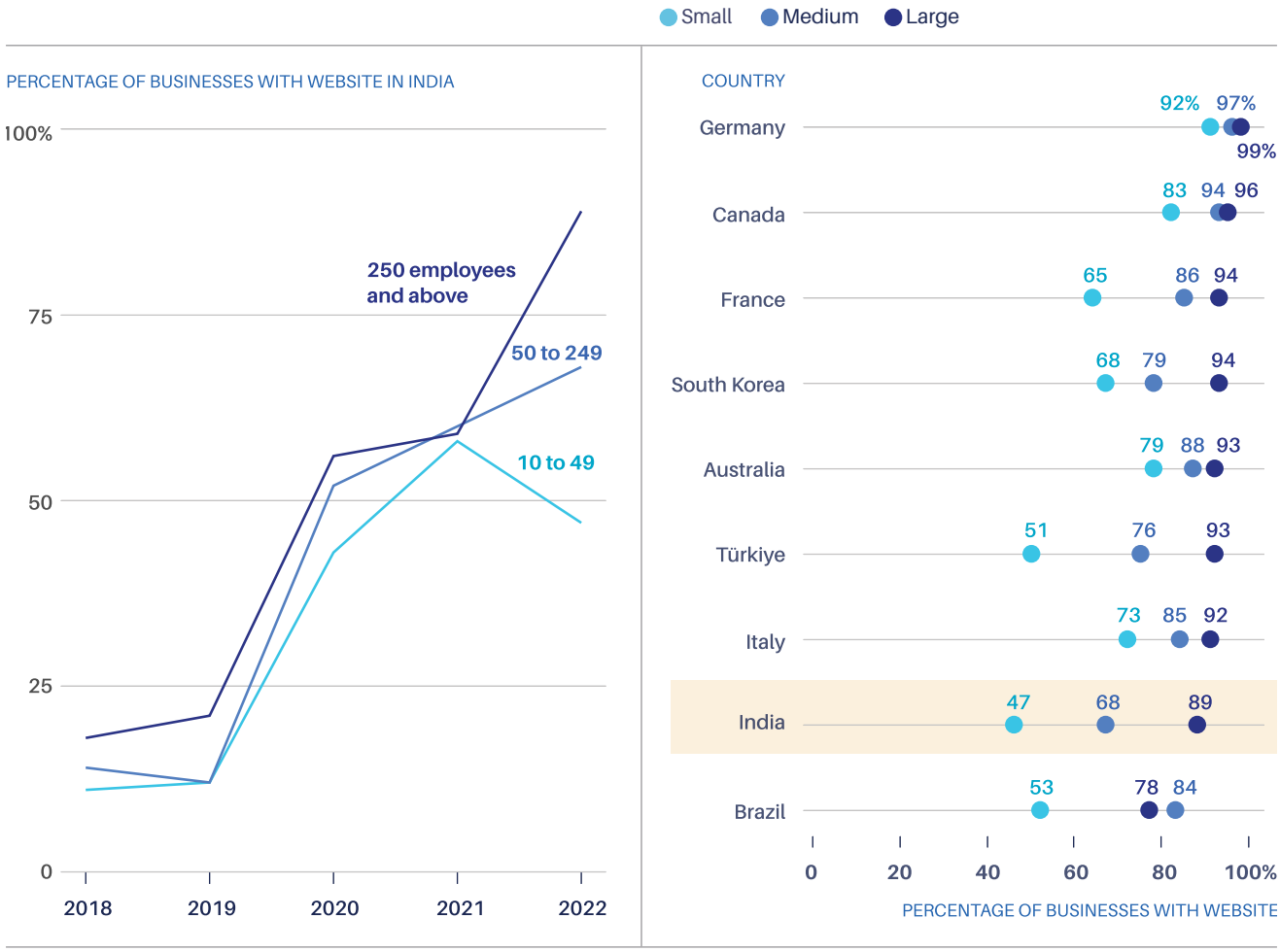
Note: Activities that invovle the transfer of knowledge or skills (self-paced or instructor-led) through online platforms. Includes online learning platforms, online university education and professional certificates. Includes service provides that use B2C or B2C and B2B sales channels.

Note: Online ordering of groceries ((non-prepared food and beverage products, household, and personal care products) and prepared meals, typically placed through an app or website.

Source: Statista Market Insights

FIGURE 21

Businesses with websites (India and Cross-Country)



Source: OECD Statistics (2023/2022) and Kantar (2022) for India.
Note:⁎ Data from 2021 ⁎⁎ India data from IMRB Kantar

While affordability is one of the primary reasons explaining India's gap in Connect, digital skills is the key driver of the gap for Harness. A recent NSSO survey pointed towards inadequate skilling among India's youth (only 27.5 percent of the population in the age group of 15-29 were reported digitally skilled).[32,33,34] There is also a huge digital literacy gap between men and women (44.8 per cent men versus 37 per cent women) can search and browse the internet).[35] Besides lacking agency to own and operate a phone, the lack of digital skills is one of the primary reasons for the persisting gender divide. The government is in the process of revamping its Skill India initiative , which focuses on digital skills including for emerging technologies such as AR/VR, machine learning, data analytics, etc.

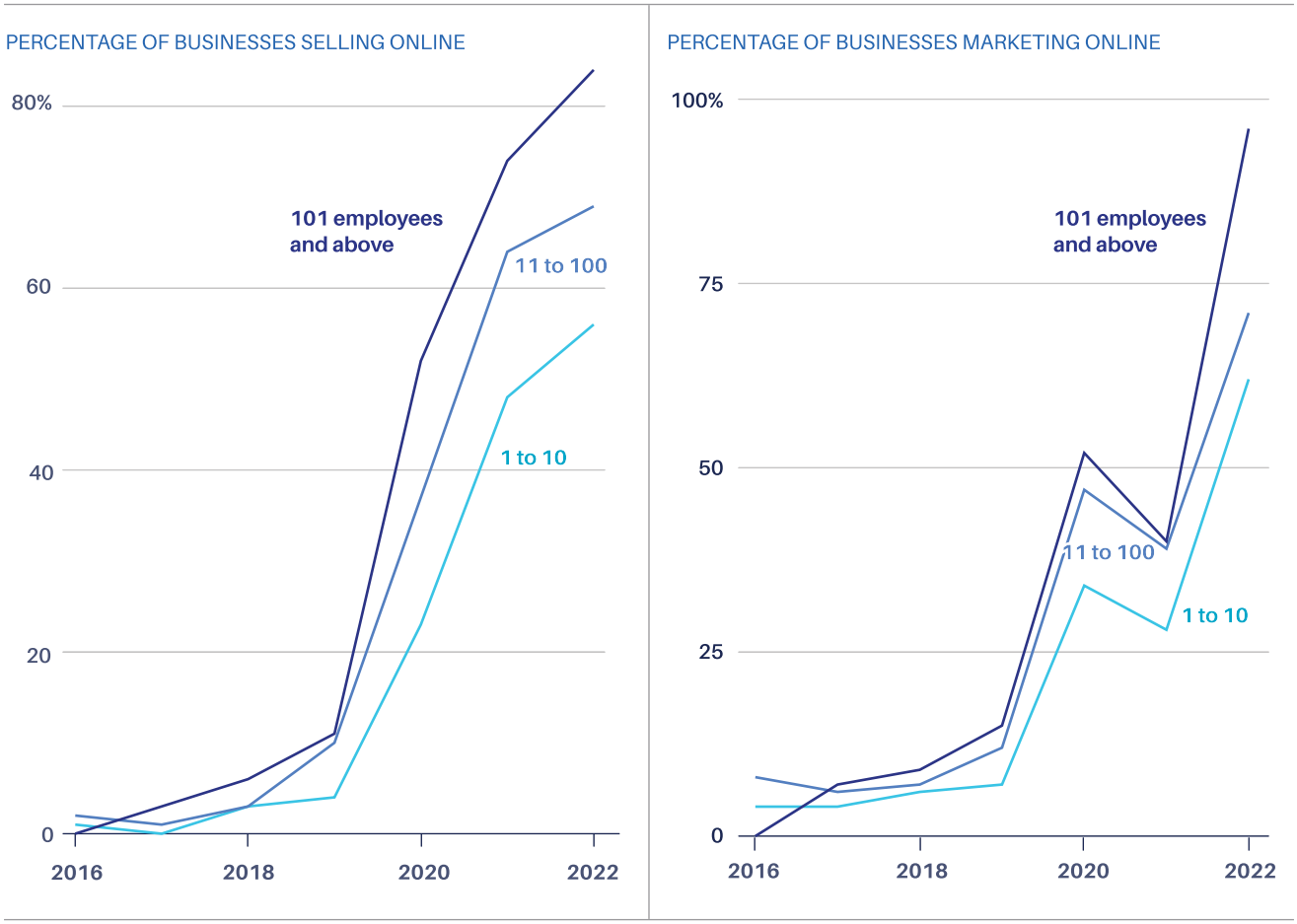
Innovate: India continues to consolidate its advantage

"India – punching above its weight", title of the innovation chapter in the SIDE 2023 report is revalidated in SIDE 2024. When measured quantitatively, CHIPS

32 Alam, A. (2023, May 02). *A digitally unprepared workforce.* National Council of Applied Economic Research
33 Gaur, D. S., & Kumari, H. (2023, September 08). *Opinion: How To Solve India's Digital Divide.* NDTV
34 Rampal, N. (2023, March 27). *India has $1 trillion digital dream, but 73% youth lack basic email skills, shows NSSO survey.* The Print
35 Kantar IMRB ITOPS, 2022

FIGURE 22

Steady increase in share of businesses marketing and selling online



Source: IMRB Kantar ITOPS

(User) confirms that India has found its place among the leading countries that are meaningfully contributing to areas like AI development. It is slowly nurturing its domestic ecosystem and creating a talent pool that will help India remain relevant to the world in the development of AI applications. According to NASSCOM's State of Data Science & AI Skills report, India has the second largest AI/ML/Big Data Analytics talent globally. The country also ranks first in AI skill penetration.[36] However, India's share in the global AI market is only 1 per cent.[37] This probably emerges from a lack of demand and untested use cases, as against the supply of technology.[38] According to a recent report, AI service providers in India are ahead of their global counterparts when it comes to capability and scale.[39] On the demand side however, broad adoption of AI is only demonstrated by sectors such as communications, gaming and financial services and the breadth of adoption is low. According to Pitchbook, India received less than 5 per cent of venture capital investments in AI in 2021, and the levels remained stagnant in 2023.

The future is likely to be more optimistic for India's AI sector. Indian AI start-ups are up against big technolo-

36 NASSCOM. (2023, February). *State Of Data Science & AI Skills In India – Data And The Art Of Smart Intelligence*
37 Sinha, V., Narayan, S., & Banerjee, S. (2022, June 28). *From Buzz to Reality: The Accelerating Pace of AI in India.* Bain and Company
38 The Economist. (2024, January 01). *Welcome to the era of AI nationalism*
39 NASSCOM. (2023, February). *State Of Data Science & AI Skills In India – Data And The Art Of Smart Intelligence*

gy firms like Microsoft and Google in the US and Baidu in China which are all deeply invested in AI and the front runners for the new generation large language models (LLM). Despite huge capex requirements and competition from big tech, Indian start-ups are bringing large language models to a variety of Indian languages. Pragna, is a foundational multilingual large language model that is trained on India's 23 scheduled languages along with English.[40] Bharat GPT supporting 12 Indian languages is also going to be offered to enterprises soon.[41] Many useful AI applications have also been identified in the areas of health and financial services. Both sectors deal with sensitive personal data and serious security challenges.

It is a promising future for AI in India, but one that must be traversed with care. Building guidelines for the ethical use of AI is the big task ahead not only for India, but for countries all over the world.

Protect and Sustain: Need to translate awareness into actions

The Protect and Sustain pillars while critically important to the longevity of harnessing digitalisation, are also the ones that are evolving with relatively few mature indicators that are measurable across countries. On Protect, India's reported attacks given the population using the internet is low and so is its preparedness. Cybersecurity spending per internet user is the lowest amongst the G20 countries and is estimated at approximately USD 8 per internet user compared to over USD 200 per internet user in the US.

There has been growing awareness and efforts by Indian businesses to strengthen cybersecurity. According to a Data Security Council of India (DSCI) Survey, close to 90 per cent of organisations identified email as the foremost pathways for cyberattacks.[42] Enterprise spending on information security and risk management grew from 1.87 billion in 2019 to 2.01 billion in 2020. The 2023 DSCI survey found that the firms in the BFSI and IT/ITeS sectors are the biggest spenders on cybersecurity due to the tightening of regulatory norms. The Indian Computer Emergency Response Team (CERT-In) issued a stringent directive in April 2022 requiring companies to maintain security logs and report cybersecurity incidents within six hours of identification, among other measures. The industry viewed this as a disproportionate burden on smaller businesses.

A growing network of internet users, broadening and deepening of the digital economy means that security and privacy preparedness need to keep up. Data governance will be at the centre of building trust in the digital economy. Effective implementation of the Digital Data Protection Act 2023 will be crucial. So will efforts towards managing the risk of misinformation. According to World Economic Forum's 2024 Global Risk Report, India faces the highest risk of misinformation.[43] False narratives can increase risks of economic uncertainty and societal rifts.

Among the vulnerabilities facing India's fast expanding digital economy is the piling up of enormous e-waste. India is third largest generators of e-waste, trailing China and US. Recognising this mammoth challenge, the government announced the new E-Waste (Management) Rules, 2022 to formalise recycling. Alongside waste management, there also needs to be sustainable digital infrastructure. Many data centres in India have well-defined sustainability strategies, relying increasingly on the use of renewable energy sources.[44] However, these are still baby steps. Building green digital tech, will require concerted policy effort, including investments in research and development of products that are energy efficient. While digital technologies might be helping industries become more energy efficient, digital infrastructure itself needs to double down on becoming more sustainable. According to a BCG report, technology has the potential of reducing

40 Roy, A. (2023, December 08). *Startups take to LLMs to bring GenAI smarts to Indian languages.* The Economic Times
41 India Today. (2024, January 14). BharatGPT: *Making PM Modi's AI vision a reality in 22 Indian languages.*
42 Based on a detailed study of 120 plus organisations
43 India Today. (2024, January 14). *BharatGPT: Making PM Modi's AI vision a reality in 22 Indian languages.*
44 Thomas, P. A. (2023, November 20). *India data center market to grow 25%, green data centers essential: CapitaLand.* Digitimes Asia

23 gigatonnes of CO_2e every year.[45]

Operating both at the global frontier and interior

In conclusion, at the level of user, India defines the frontier for four sub-pillars – AI, investments and start-ups, real economy and cyberattacks (see Figure 23). India is a front runner with high ranks, both in an absolute and relative sense, for the first three. On cyberattacks, India must exercise caution and work towards better preparedness, as the lower attacks can be a function of the scaling effect by user as well as lower reporting. As pointed out by several recent reports on cyber threats, India is vulnerable to cybercrimes in the years to come.[46,47,48] This also hold true for other sub-pillars like green digital tech and trust that come close to the frontier. The quantitative measurement indicate India is neither championing commercialising green tech nor building adequate safeguards from cyber harms.

For many sub-pillars that are at a moderate distance or far away from the global frontier, the primary reason is relative scale. According to GSMA, while the coverage gap for internet access has reduced substantially from 24 per cent in 2014 to 4 per cent in 2022, the usage gap has fallen modestly from 45 percent in 2014 to 41 per cent in 2022. The reasons for high usage gap gap are reflected in the access indicators, which is driven by affordability and in the apps and platform indicators, which is driven by the lack of population-scale digital literacy. Performance in financial services is a combination of affordability and lack of digital skills. Cherry picking emerging technologies such as AI, have left others such as IoT, AR/ VR, metaverse, etc. to the fancy of the private sector, which has seen comparatively low traction.

The two critical aspects of the future of digital economy – Protect and Sustain, certainly need policy focus for the other pillars - Connect, Harness and Innovate to prosper

Key takeaway

The CHIPS (Economy) and CHIPS (User) are complementary ways of viewing the state of India's digital economy. CHIPS (Economy) reflects the enormous scaling up that India has been able to achieve in connecting millions to the internet and enabling use of digital services, including digital disbursement of welfare benefits, which is not ordinarily visible in most global indices. CHIPS (User), which is more aligned to the method of global indices, highlights India's record performance in AI and the start-up economy, despite gaps in connectivity and persistent digital divides. Both perspectives are important for policy makers. The success of the DPI approach as a policy choice in providing scale should be celebrated, while the lack of basic infrastructure, digital literacy and challenges of affordability need to be worked upon. An approach that combines the lens of CHIPS (Economy) and CHIPS (User), therefore, can become an effective tool to measure digitalisation, especially for developing countries like India that do not walk the beaten path of developed countries.

45 Scalabre, O., Pieper, C., Kim, M., Baker, T., Pidun, U., Schrapp, S., Bastard, F., & Guyomar, P. (2023, May 23). *Fast-Tracking Green Tech: It Takes an Ecosystem.* Boston Consultancy Group.

46 Data Security Council of India. (2023). *India Cyber Threat Report 2023*

47 The International Institute for Strategic Studies (IISS). (n.d.). *Cyber Capabilities and National Power: Net Assessment*

48 Bhattacharya, D. (2022, August 19). India's Cyber Security Policy: Strategic Convergence and Divergence with Quad. *Institute for Security & Development Policy*

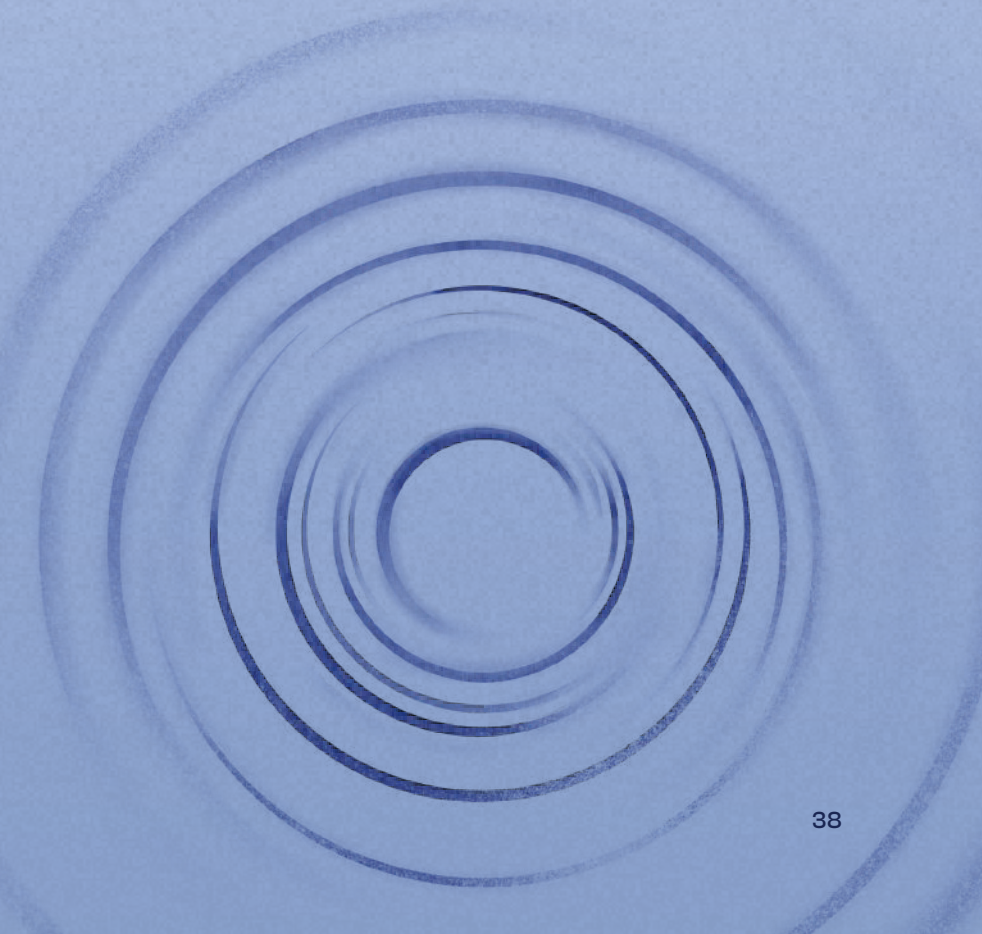
FIGURE 23

India against the Global Frontier CHIPS (Users)

Source: IPCIDE Team

PART 2

India and its States



Measuring digitalisation of Indian States

Richer states and UTs on average are more digitalised.

As is the global trend, richer states and union territories (UTs) in India have relatively higher levels of digitalisation. The top five states according to the CHIP score – Karnataka, Maharashtra, Telangana, Gujarat and Haryana – are also amongst the richer states in India (see Table 4). Among UTs and smaller states (population less than 1 crore) as well, Delhi and Chandigarh rank as the top two and have the highest per capita incomes (see Figure 24).

TABLE 4

Sub-national rankings and scores for CHIP

Large States (population > 1 crore)

Rank	Name	CHIP Score
1	Karnataka	58.7
2	Maharashtra	52.6
3	Telangana	50.8
4	Gujarat	49.7
5	Haryana	48.6
6	Kerala	48.1
7	Tamil Nadu	47.3
8	Andhra Pradesh	42
9	Punjab	41.3
10	Rajasthan	41
11	Uttarakhand	37.6
12	Uttar Pradesh	35.8
13	West Bengal	35.5
14	Chhattisgarh	34.6
15	Assam	33.8
16	Madhya Pradesh	33.4
17	Odisha	33.1
18	Jharkhand	31.6
19	Bihar	25.6

UTs and Small States (population < 1 crore)

Name	CHIP Score
Dēlhi	64.6
Chandigarh	57.2
Mizoram	49.9
Sikkim	47.1
Andaman & Nicobar	45.1
Goa	43.9
J&K	42.4
Meghalaya	42.3
Dadra & Nagar Haveli, Daman & Diu	42
Himachal Pradesh	39.9
Nagaland	37.6
Manipur	37.5
Tripura	33.4
Arunachal Pradesh	26.5

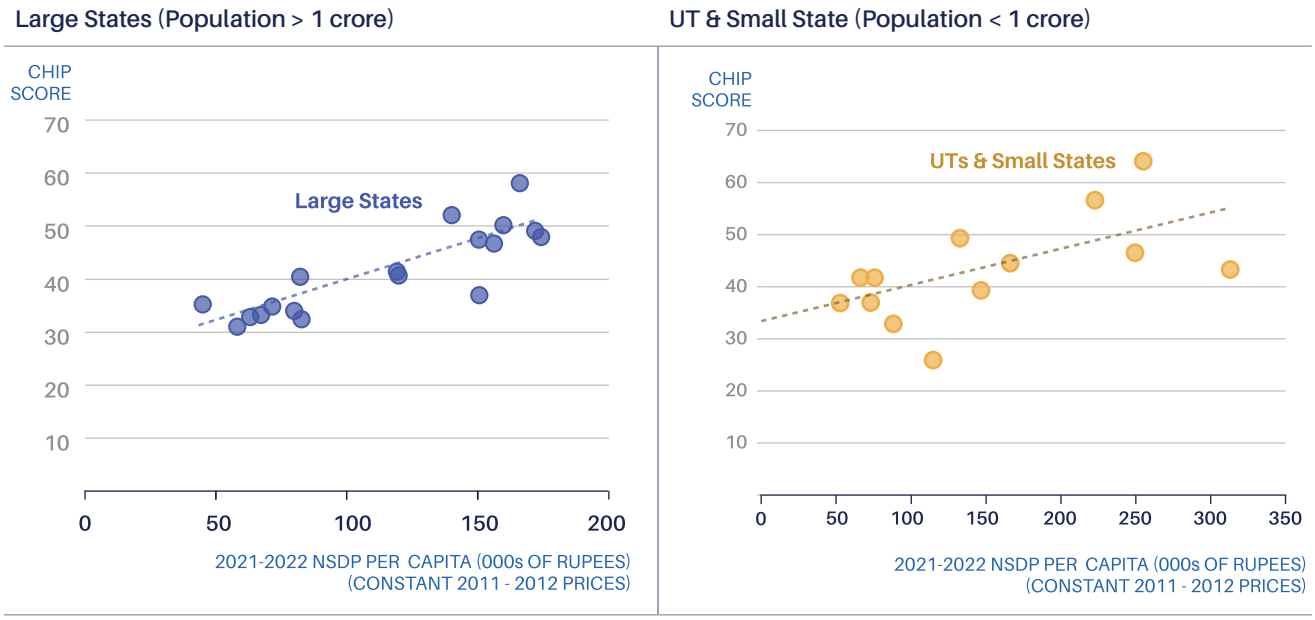
*Ranking within groups: Large States (population > 1 crore) and UTs and Small States (population < 1 crore), while the scores are standardised across the combined sample. * Ladakh and Lakshadweep are not included in the ranking due to unavailability of data for several indicators*

Ranking of states and UTs compares well with ranking of other state-level indices. The States Start-up Ranking 2023 reports Karnataka and Gujarat among the top five states, overlapping with the frontrunners in the CHIP (sub-national) ranking.[49] Among the seven states in the top performers category for Ease of Doing Business rankings reported in 2022 – five of them, namely Gujarat, Telangana, Haryana, Kerala and Tamil Nadu – are also among the top seven in the CHIP ranking.[50] In addition, the India Innovation Index (2021) ranked Karnataka, Telangana, Maharashtra, Tamil Nadu and Uttar Pradesh as the top five major states, three of which overlap with CHIP.[51] While the predominant reason for common results in ranking could be the levels of income, the indices also overlap in the selection of indicators. As we move along to the sub-pillar level, we find that income alone does not explain the differences in the level of digitalisation.

No single state dominates the ranking table at the sub-pillar level. Top performer positions (top five) are shared by nine different states (see Figure 25). Chhattisgarh, which is the 12th richest state by per capita income among the larger states, also holds the top position in two sub-pillars, namely inclusion (gender) and public services (general). In 2022, Chhattisgarh won the golden award for innovation in e-governance, implemented through *e-Shramik Seva*.[52] It has also won other awards for tele-practices in education.[53] Similarly, other relatively poorer states like Madhya Pradesh and Odisha feature in the top five for public services where e-government services are improving steadily.[54] For the smaller category states, Delhi holds the top rank in seven out of fourteen indicators, while the remaining positions are taken up by other UTs and smaller states (see Figure 26). Among the north-eastern states, Mizoram fares well across a series of indicators and Tripura leads in providing digital public services.

FIGURE 24

Sub-national rankings for CHIP is positively correlated with income



Source: IPCIDE Research and RBI Statistical Handbook. Note: NSDP values for 2022-23 linearly extrapolated based on data from 2015-16 to 2021-22 for A&N Islands, Arunachal Pradesh, Chandigarh, Goa, Gujarat, Kerala, Maharashtra, Manipur, Mizoram, Nagaland, Puducherry.

49 Startup India. (2023). *States' Start-up Ranking 2022 Results.* DPIIT, Government of India
50 Livemint. (2022, June 30). *These 7 states are top achievers in 'ease of doing business' rankings.*
51 Kapoor, A. & Sinha, N. (2022, July 21). *India Innovation Index 2021.* NITI Aayog. Institute for Competitiveness.
52 Times News Network. (2022, January 9). *Chhattisgarh bags award for innovation in e-governance.* The Times of India
53 Ibid
54 Planning and Convergence Department. (2023, February). *Odisha Economic Survey 2022-23.* Government of Odisha.

FIGURE 25

Top five major states in terms of digitalisation at the sub-pillar level

Pillar	Sub-pillar	#1	#2	#3	#4	#5
CONNECT	Access (Individual)	Maharashtra	Telangana	Kerala	Haryana	Gujarat
	Inclusion (Geography)	Karnataka	Punjab	Maharashtra	Tamil Nadu	AP
	Inclusion (Gender)	Chhattisgarh	Punjab	Telangana	Haryana	Kerala
	Quality	Karnataka	Haryana	Telangana	Tamil Nadu	UP
	Affordability	Rajasthan	Kerala	Uttarakhand	Haryana	Assam
	Access (Government)	Gujarat	Punjab	Kerala	Maharashtra	Jharkhand
HARNESS	Apps and Platforms	Kerala	Maharashtra	Gujarat	Tamil Nadu	Haryana
	Public Services (General)	Chhattisgarh	MP	Gujarat	Uttarakhand	Odisha
	Public Services (DPI)	AP	Telangana	Kerala	Chhattisgarh	Haryana
INNOVATE	Investment & Start-ups	Maharashtra	Karnataka	UP	Haryana	Tamil Nadu
	Business Innovation	Telangana	Maharashtra	Karnataka	Tamil Nadu	Uttarakhand
	Knowledge Production	Tamil Nadu	Karnataka	Telangana	Kerala	AP
PROTECT	Cybercrime Reporting	Uttarakhand	Bihar	Chhattisgarh	West Bengal	MP
	Cyber Resolution Mechanisms	Karnataka	Telangana	Rajasthan	UP	Gujarat

FIGURE 26

Top five smaller states and UTs in terms of digitalisation at the sub-pillar level

Pillar	Sub-pillar	#1	#2	#3	#4	#5
CONNECT	Access (Individual)	Delhi	Chandigarh	Goa	Mizoram	DDNH
	Inclusion (Geography)	Goa	Sikkim	J&K	DDNH	Mizoram
	Inclusion (Gender)	Chandigarh	Goa	Himachal Pradesh	Delhi	J&K
	Quality	Delhi	Chandigarh	J&K	Tripura	A&N Islands
	Affordability	Meghalaya	Delhi	J&K	Chandigarh	Sikkim
	Access (Government)	Delhi	Chandigarh	Goa	J&K	Mizoram
HARNESS	Apps and Platforms	Delhi	Chandigarh	J&K	Goa	DDNH
	Public Services (General)	Tripura	J&K	Lakshadweep	Mizoram	Meghalaya
	Public Services (DPI)	DDNH	Lakshadweep	A&N Islands	Delhi	Chandigarh
INNOVATE	Investment & Start-ups	Delhi	Goa	Chandigarh	Manipur	Tripura
	Business Innovation	Delhi	DDNH	Goa	Chandigarh	Himachal Pradesh
	Knowledge Production	Delhi	Chandigarh	Nagaland/ Sikkim	-	Goa
PROTECT	Cybercrime Reporting	Ladakh	Lakshadweep	Mizoram	Sikkim	Tripura
	Cyber Resolution Mechanisms	Ladakh	Lakshadweep	Mizoram	Sikkim	Tripura

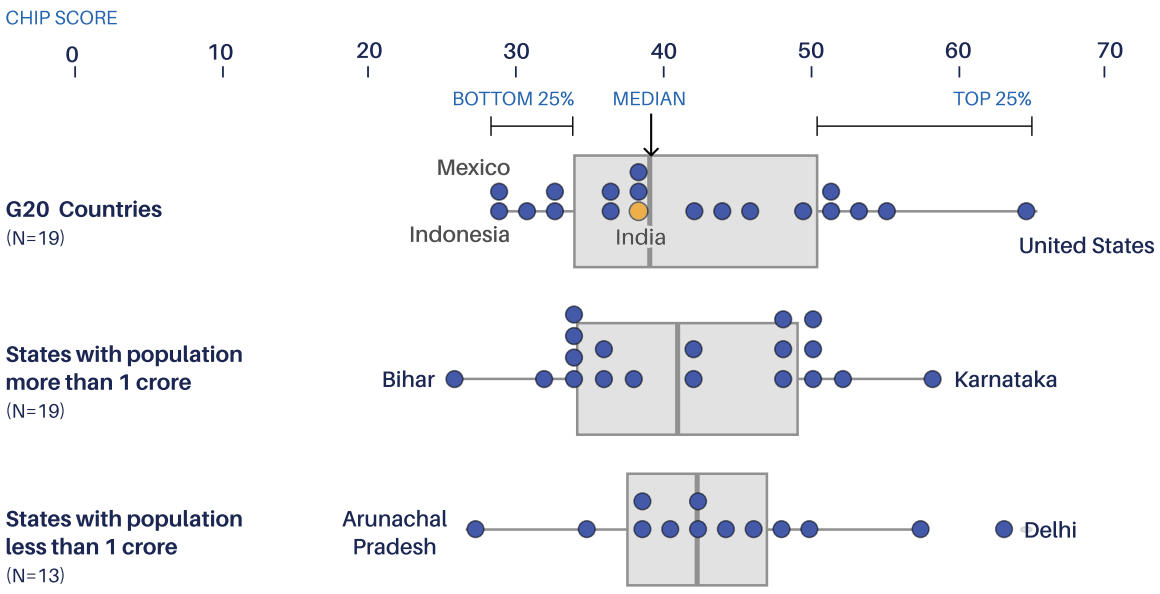
Source: IPCIDE Research | Note: Ladakh and Lakshadweep have only been included in the ranking of sub-pillars where data is available

Dispersion in the level of digitalisation across Indian states is less than that for G20 countries. The CHIP score for larger states in India have a smaller range (difference between the maximum and minimum value) compared to the score for CHIP(User) for G20 countries. Moreover, most states are concentrated within a shorter inter quartile range (see Figure 27). The result is not entirely unexpected. Uniform national-level policies (telecom and IT are in the Union list), common infrastructure and homogeneity in cultural norms and consumption patterns implies that state performances are likely to be less unequal than in other countries, which are different not only in terms of economic variables such as income and infrastructure, but also policy making and other non-economic variables. While the range for the group of small states and UTs is higher than that for large states and G20 countries, the inter-quartile range is much smaller. Delhi and Chandigarh are outliers, performing exceptionally well given their special status and primarily urban nature. The performance of rest of the UTs and small states is relatively homogenous despite their varying socio-economic contexts.

Publicly provided digital services appear to have relatively lower dispersion than privately provided ones. For example, sub-pillars like public service delivery through DPI and gender inclusion have relatively lower dispersion across states. On the other hand, sub-pillars measuring individual access, business innovation, geographic inclusion and private services on apps and platforms exhibit wider variation (see Figure 28). Successful states are the ones that are able to make consistent progress in all dimensions of digitalisation. Telangana displays high mean and low variance in its performance across all sub-pillars while Bihar has low mean and low variance across all sub-pillars (see Annexure 5).

FIGURE 27

Comparing dispersion in cross- country and sub-national ranking using CHIP



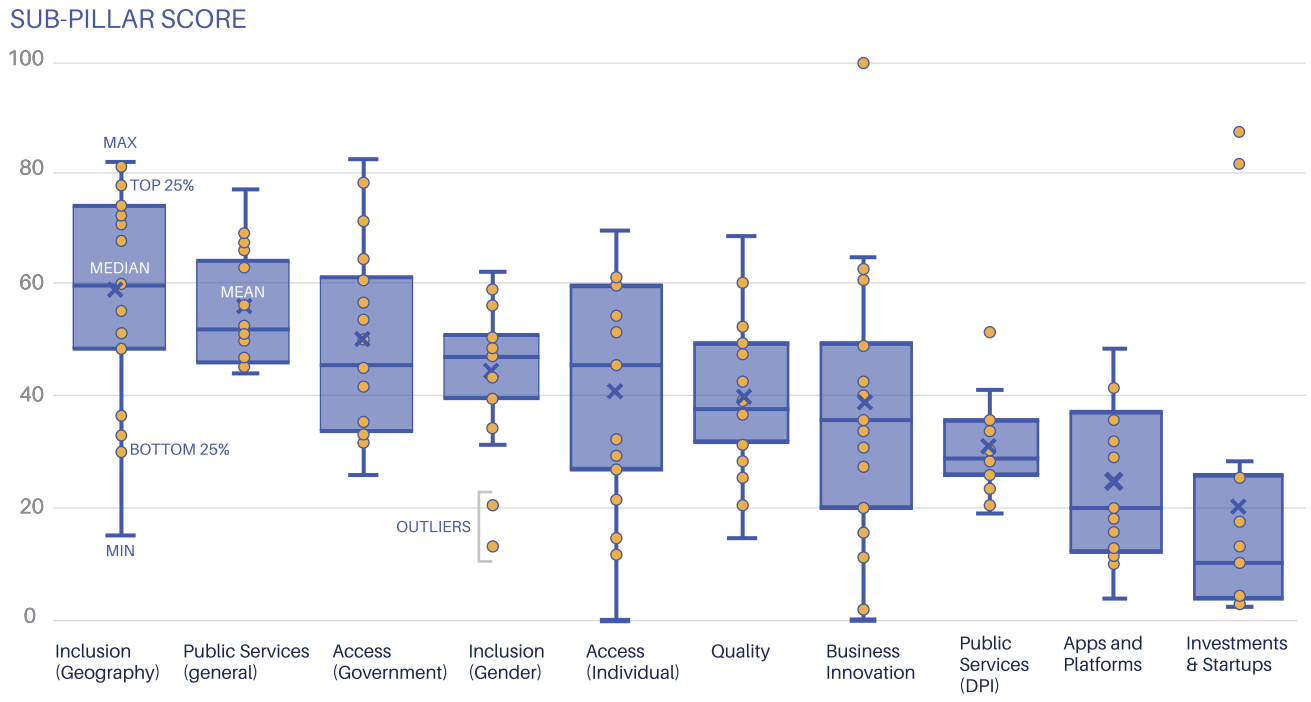
Source: IPCIDE Research

Note: To enable comparison with the sub-national indices, the scores for the G20 countries for CHIP (Economy) and CHIP (user) were recalculated using the same weights for the four CHIP pillars as the sub-national index, and leaving out the S pillar (i.e., 2/7th for C, 2/7th for H, 2/7th for I and 1/7th for P).

The 'whiskers' of the plot show the maximum and minimum values, and the 'box' shows the third quartile, the median and the first quartile.

FIGURE 28

Dispersion in performance across different sub-pillars

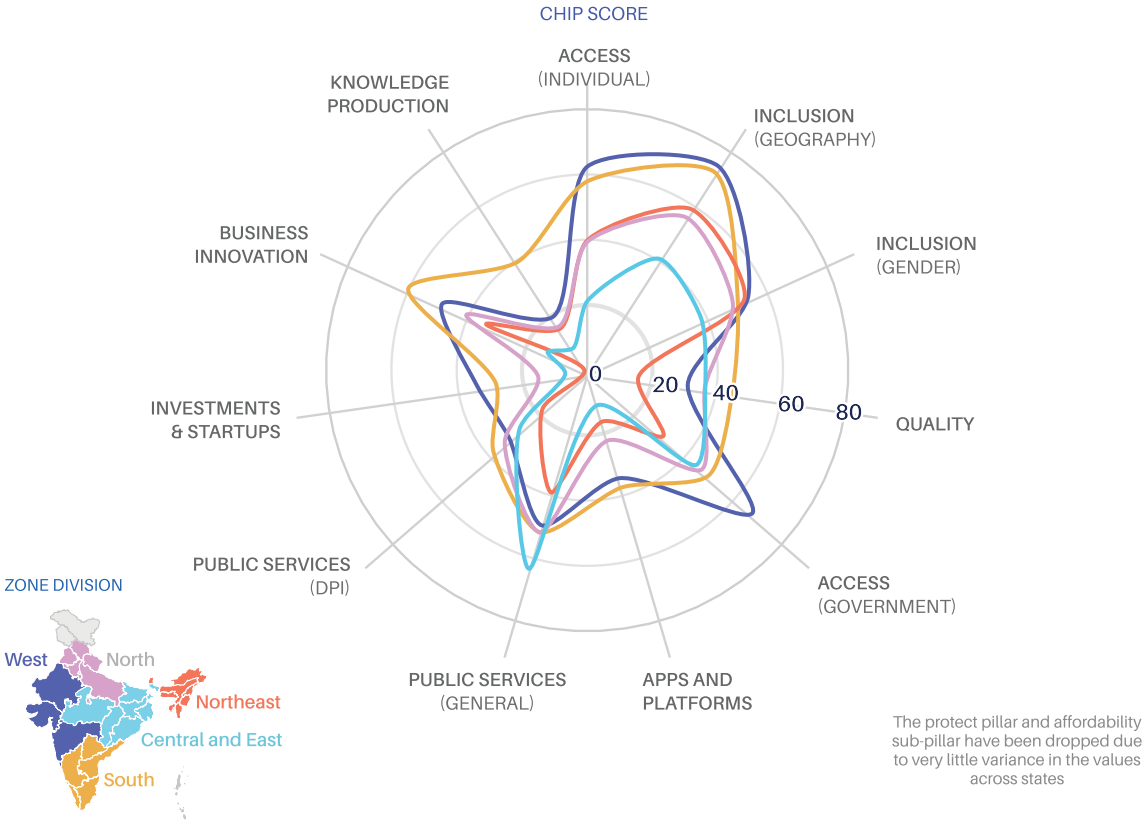


Source: IPCDIE Research

There are some clear regional trends in the level of digitalisation. On average, states in the West and South are doing much better than states in North, Central, East and North East. The Southern region particularly stands out in the quality of access, knowledge production and business innovation sub-pillars, while the western region stands out in the access (government) sub-pillar. While the north-eastern states fare poorly on sub-pillars of quality, access (government), public services (general), public services (DPI), investments and start-ups, and cybercrime resolution mechanisms, they do well on gender (inclusion). The Central and Eastern states have the lowest score for seven sub-pillars – access (individual), inclusion (geography), inclusion (gender), affordability, apps and platforms, business innovation and knowledge production – but score very well on public services (see Figure 29)

FIGURE 29

CHIP at the sub-regional level



Source: IPCIDE Research

Note: Sub-pillar scores for each state have been averaged by region. The division is as follows - South: Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana; West: Gujarat, Maharashtra, Rajasthan, Goa; Northeast: Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim; North: Haryana, Punjab, Uttar Pradesh, Uttarakhand, Himachal Pradesh; Central and East: Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, West Bengal.

Connect

Combination of universal and meaningful

There is convergence in connectivity between the leading and aspirational states. While Karnataka, Haryana and Gujarat are the most connected large states, the ones that have seen the most growth in the last seven years are Bihar, Uttar Pradesh, Odisha and Madhya Pradesh – states with the lowest subscriber density in 2016 (see Figure 30). High growth rates are mostly driven by the low base, as larger states are moving into saturation zones. Among the UTs and small states, Delhi, Chandigarh and Goa are the top three, J&K on fourth, saw the highest increase in tele-density within this grouping.

TABLE 5

Ranks and scores for the Connect pillar

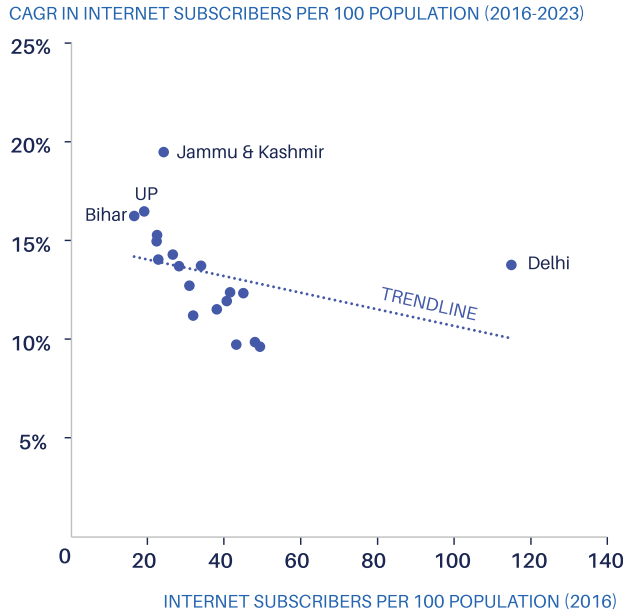
	Large States (population > 1 crore)		UTs and Small States (population < 1 crore)*	
Rank	Name	Score	Name	Score
1	Karnataka	66.2	Delhi	84.7
2	Haryana	65.3	Chandigarh	82.3
3	Gujarat	64.2	Goa	65.6
4	Punjab	63.4	J&K	61.2
5	Kerala	62.5	Mizoram	50.9
6	Maharashtra	61.8	Himachal Pradesh	50.0
7	Tamil Nadu	59.7	Meghalaya	45.6
8	Rajasthan	57.9	Andaman& Nicobar Islands	45.4
9	Telangana	57.5	Sikkim	43.6
10	Andhra	53.0	Tripura	41.6
11	Assam	47.9	Nagaland	41.4
12	West Bengal	46.9	Arunachal Pradesh	36.0
13	Odisha	46.4	Manipur	35.0
14	Jharkhand	45.6	Dadra & Nagar Haveli, Daman & Diu	21.4
15	Uttarakhand	43.0		
16	Uttar Pradesh	37.4		
17	Chhattisgarh	36.2		
18	Madhya Pradesh	33.6		
19	Bihar	31.2		

*Rankings within groups: Large States (population > 1 crore) and UTs and Small States (population < 1 crore), while the scores are standardised across the combined sample. * Ladakh and Lakshadweep are not included in the ranking due to unavailability of data for several indicators*

FIGURE 30

Convergence between leading states and aspirational states

States that had the lowest saturation in 2016 – UP, Bihar, J&K have grown the fastest between 2016 - 2023



Source: TRAI Performance Indicators Report 2016 - 2023

States with higher scores in the Connect sub-pillars for access (individuals) are also the ones with better infrastructure, both wireless, reflected by higher Base Transceiver Station (BTS) density, and wireline by higher number of fiberized towers (see Figure 31). However, states with more infrastructure are not necessarily the states with better quality. In other words, the correlation between a quality indicator – median download speeds -- and the availability of infrastructure is not statistically significant (see Annexure 6).[55] On the other hand, we find that states with higher 5G rollouts also have on average better-quality networks (see Figure 32). Migration to newer generation networks is known to play an important role in improving network quality. As stated in Part I, the presence of 5G has helped India improve its rank by 10 spots in the Ookla Speedtest Global index.[56] However, at the same time, consumers are experiencing more call drops, lowering quality of service despite the increase in speed.[57]

Additionally, India has not been making adequate investments to upgrade its digital infrastructure. The national target for tower rollout was 12 lakhs in 2023-24. However, according to recent data provided by the Digital Infrastructure Providers Association (Dipa), only 739,000 telecom towers have been deployed in the country.[58] Much of this infrastructure is created by the private sector. Consequently, less marketable zones – poorer states, sparsely populated states, etc. – are the ones with less infrastructure. Besides demand, investments in infrastructure are also constrained by market concentration and regulatory bottlenecks. For instance, fibre deployment requires right of way (RoW) access that is usually costly and tedious. The new Telecom Act has clearly stated its intent to ease RoW access and further enable infrastructure sharing to lower cost of access. Another key aspect is spectrum availability. Recent changes in spectrum management policies have enabled efficient use of spectrum.[59] Additionally, the allocation of mid-band spectrum (above 1 GHz) has helped service providers expand capacity and is one of the reasons behind improvements in network quality. [60]

In order to reach the last mile and achieve universal connectivity, the government recently announced the third phase of Bharat Net with significant improvements in implementation strategy.[61] This includes an upgrade from the linear architecture to ring-based topology, extending connectivity from *gram panchayats* to unconnected villages and promoting village-level entrepreneurship for operations, maintenance and monetisation of the infrastructure.

55 These outcomes may not appear intuitive but can be explained by the fact that average speed data is crowdsourced from users. People reporting test results are likely to be from urban areas with relatively higher digital skills.

56 Ookla. (2023). *Speedtest Global Index.*

57 Ibid

58 Indo-Asian News Service (IANS). (2023, March 13). *65% telecom towers need fiberisation; 12L towers to be deployed to make India 5G-ready.* Telecom.com, The Economic Times

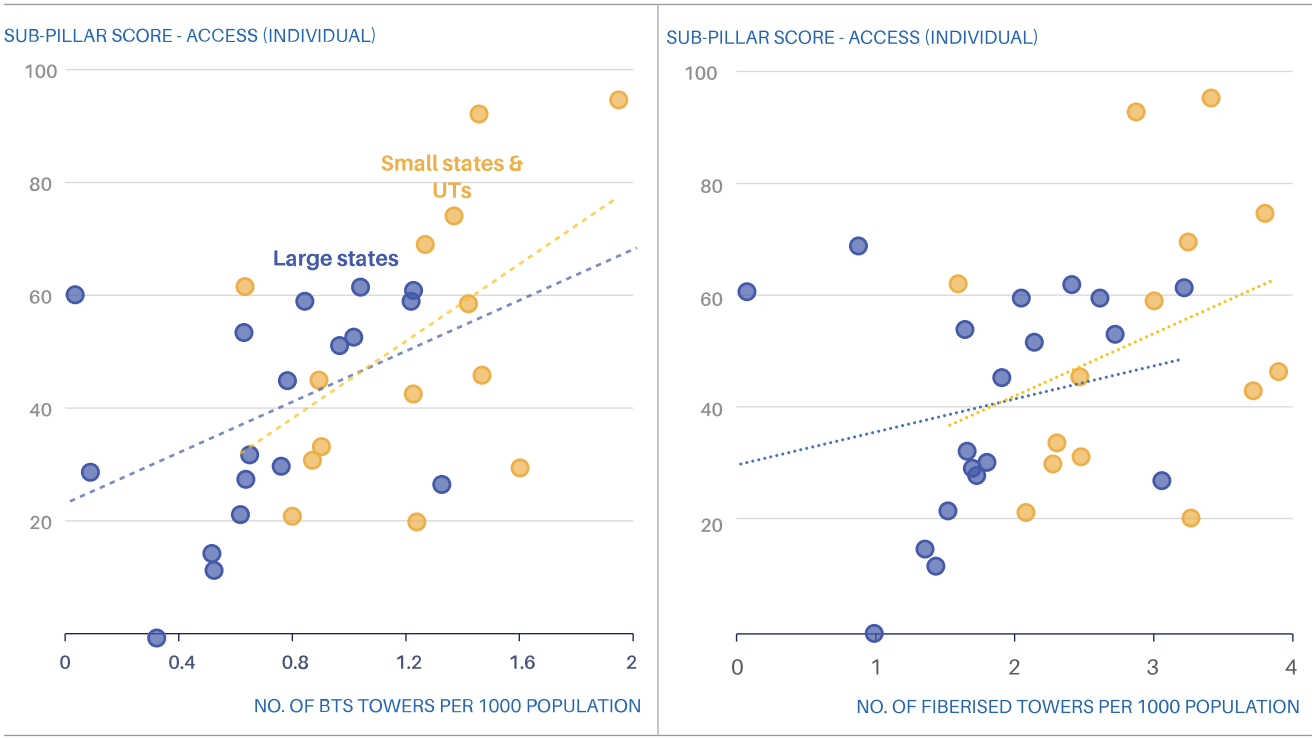
59 Kathuria, R., Kedia, M., Sekhani, R. & Bagchi, K. (2019, April). *Evaluating Spectrum Auctions in India.* ICRIER.

60 GSMA. (2023). *The Mobile Economy*

61 Universal Service Obligation Fund (USOF). (n.d.). Ministry of Communications, Government of India.

FIGURE 31

State infrastructure improves access among Individuals



Source: IPCIDE Research and Lok Sabha Starred Questions

FIGURE 32

5G rollouts are enabling improvements in network quality

Source: IPCIDE Research and Lok Sabha Questions

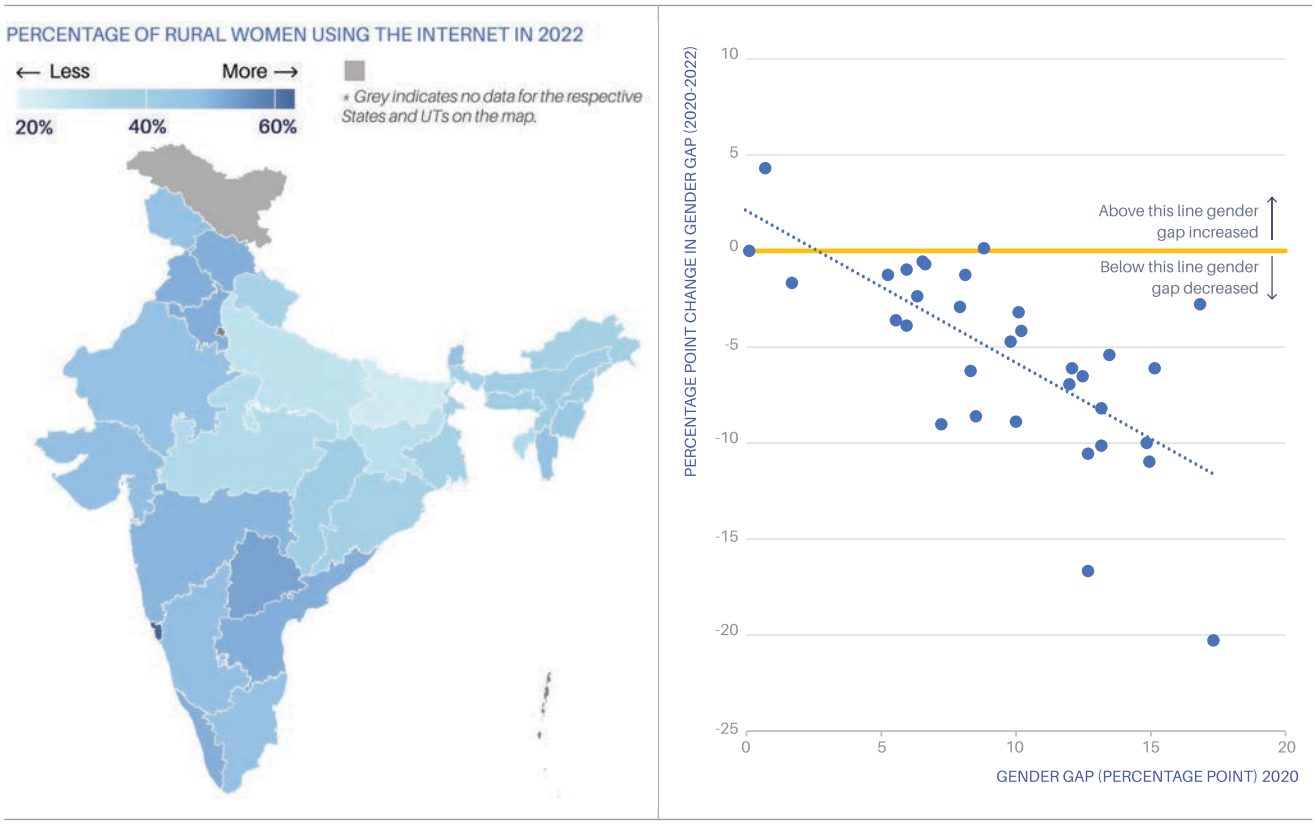
Moreover, *Digital Nidhi Bharat*, the erstwhile Universal Service Obligation Fund (USOF), has also been revamped for better utilisation of funds. Fund utilisation will no longer be restricted to supply of infrastructure but will also be utilised for research and development of indigenous technologies.[62] The role of the state is going to be crucial in bringing the unconnected to the internet.

There has been a sharp increase in women's access, narrowing the digital divide. The increase was driven by improvements in access for rural women. States with the largest rural gender gaps saw the sharpest decline (see Figure 33). Uttar Pradesh and Madhya Pradesh were two states with relatively low rural female access that saw large reductions in the gender gap. States like Jharkhand, however, continued to see an increase in rural gender gap. The highest growth in women users was in the 35+ age group, and from the North and East regions. This sharp increase can be explained by a trend of greater sharing of devices by women in rural households where men tended to be the primary users (see Annexure 7). Overall, the access to rural women still remains small, the highest being 63 per cent for Goa and the lowest being 24 per cent in Bihar. Increasing internet access among women is a government priority and was endorsed by G20 countries during India's presidency.[63]

Connectivity to government institutions in social sectors lags behind law-and-order departments (see Figure 34). Most states, including the smaller states and UTs, have all their police stations connected to the internet. The only states where police stations are

FIGURE 33

Declining Rural Gender Divides: States with Higher Gaps Experienced the Sharpest Decline



Source: IMRB ICube 2022 and 2020

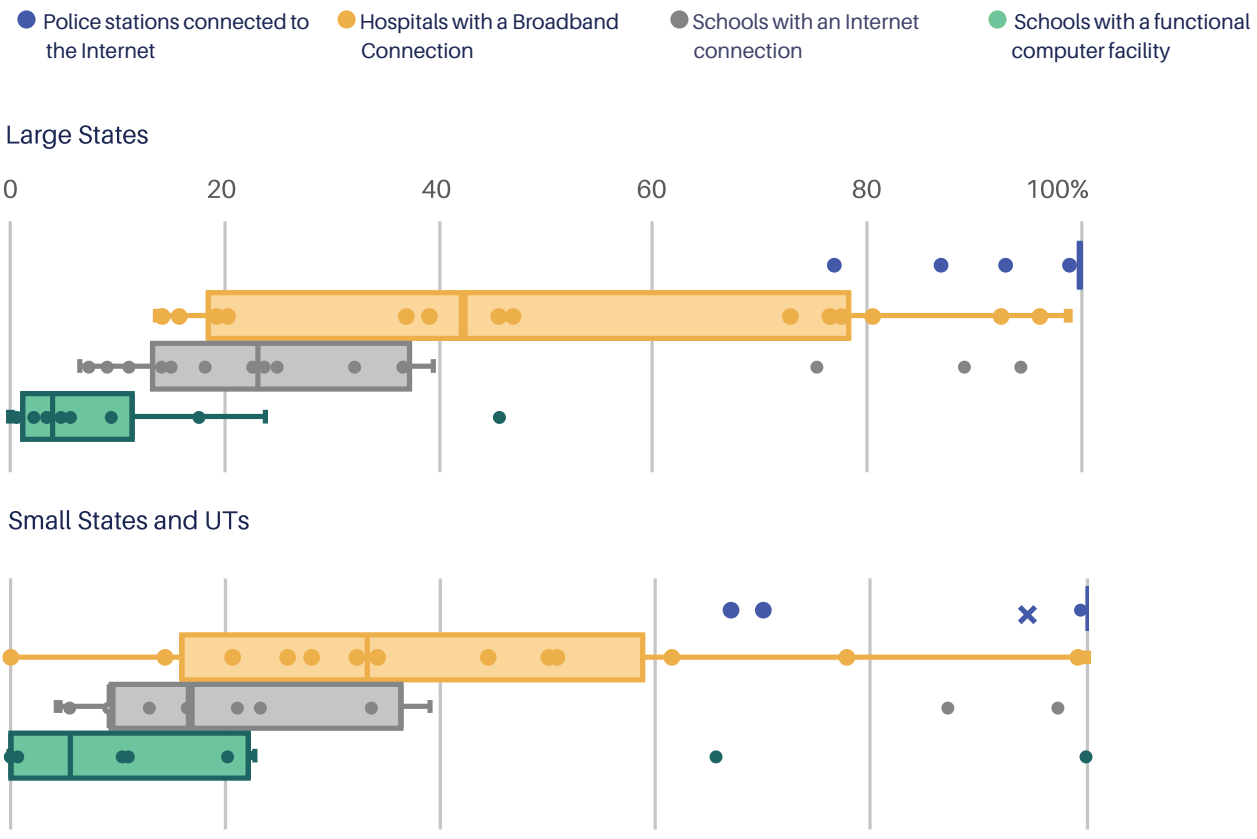
62 Ibid

63 Mehta., A. (2023, September 13). *The G20 agenda for bridging the gender digital gap.* NCAER.

not universally (near universally) connected are West Bengal (77 per cent), Bihar (87 per cent), Arunachal Pradesh (70 per cent) and Manipur (67 per cent). The Crime and Criminal Tracking Network Systems (CCTNS) came as a mandate from the Central government in 2009 to connect 14,000 police stations and 6000 other enforcement agencies.[64] With a budgetary allocation of Rs.2,000 crore, connectivity to police stations increased rapidly across the country.[65] In the absence of a similar programmatic approach, the average connectivity of schools and hospitals is not only poor, it also varies significantly across states. Less than 20 per cent schools in Odisha, West Bengal, Meghalaya, Madhya Pradesh, Bihar and Assam have a computer facility and less than 10 per cent schools in Tripura, Odisha, Mizoram, Meghalaya, Bihar, Assam and Arunachal Pradesh are connected to broadband.[66] The poorest outcomes are for broadband connectivity to hospitals. The average share of hospitals connected to broadband across the country is about 16 per cent.[67] The Digital India mission can be achieved only when individuals, businesses and government institutions are brought online. Connectivity to public institutions must become a priority for the government, both at the Centre and state levels.

FIGURE 34

Law and order departments are better connected than social sector institutions



Source: IPCIDE Research, NCRB; Directorate General of State Health Services - National Health Profile, 2021 and Letter from BBNL, dated 27.05.2020; and UDISE +.

64 Mohan, V. & Singh, M K. (2012, June 14). *Govt's plan to connect all police stations, higher offices under CCTNS likely to get extension.* The Times of India
65 Ibid
66 UDISE+. (2022, October 10). *Report on Unified District Information System For Education Plus (USIDE+).* Ministry of Education, Government of India
67 Data as of 2020, data missing for Mizoram, Nagaland, Himachal Pradesh, Haryana, Gujarat, Goa, Delhi, Dadra Nagar Haveli, Daman and Diu.

Harness

Market caters to the richer states while poorer states rely more on the public sector

Despite relatively low levels of connectivity, some of the poorer states are doing well in harnessing digital technologies(See Table 6). For example, Chhattisgarh and Uttarakhand are two unusual states to enter the top ten for harness. The two states, along with West Bengal, Madhya Pradesh, Jharkhand and Odisha, are states with high scores on public services (see Figure 35). The usual high performing states – Maharashtra, Haryana, Kerala and Telangana – perform better on private services (apps and platforms) but fall below the median score for public services. Karnataka Gujarat and Andhra Pradesh score high on both. In other words, where private sector driven adoption of services are lower, government services are enabling the adoption and diffusion of digital services. Some states like Assam are lagging in both. Among the set of smaller states and UTs, Mizoram is doing well in adopting both public and private services, while Nagaland, Arunachal Pradesh and Manipur are lagging both.

TABLE 6

Ranks and scores for the Harness pillar

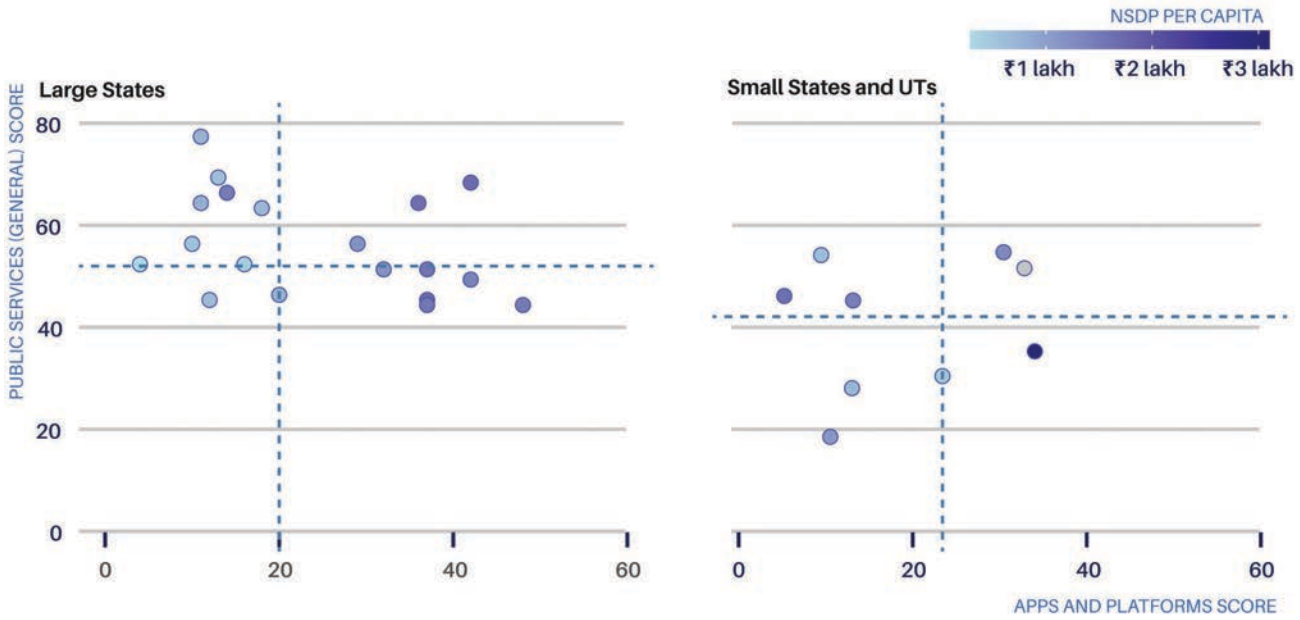
	Large States (population > 1 crore)		Small States and UTs (population < 1 crore)*	
Rank	Name	Score	Name	Score
1	Andhra Pradesh	45.3	Lakshadweep	59.2
2	Gujarat	44.6	Delhi	57.0
3	Karnataka	44.3	Dadra & Nagar Haveli, Daman & Diu	51.7
4	Kerala	42.7	Chandigarh	50.9
5	Telangana	42.3	Sikkim	38.7
6	Chhattisgarh	41.1	J&K	38.0
7	Maharashtra	40.8	Goa	37.2
8	Haryana	38.8	Mizoram	36.4
9	Uttarakhand	37.6	Andaman & Nicobar Islands	36.3
10	Punjab	37.5	Himachal Pradesh	33.7
11	Madhya Pradesh	36.4	Tripura	31.8
12	West Bengal	36.3	Meghalaya	24.7
13	Tamil Nadu	35.5	Manipur	22.8
14	Odisha	34.3	Arunachal Pradesh	15.3
15	Rajasthan	30.4	Nagaland	15.0

Rank	Name	Score	Name	Score
16	Uttar Pradesh	30.2		
17	Jharkhand	29.1		
18	Assam	25.1		
19	Bihar	25.0		

Source: Ranking within group: Large States (population > 1 crore) and UTs and Small States (population < 1 crore), while the scores are standardised across the combined sample.
**Ladakh is not included in the ranking due to unavailability of data for several indicators*

FIGURE 35

Public services substituting for low off-take of private services in poorer states



Source: IPCIDE Research

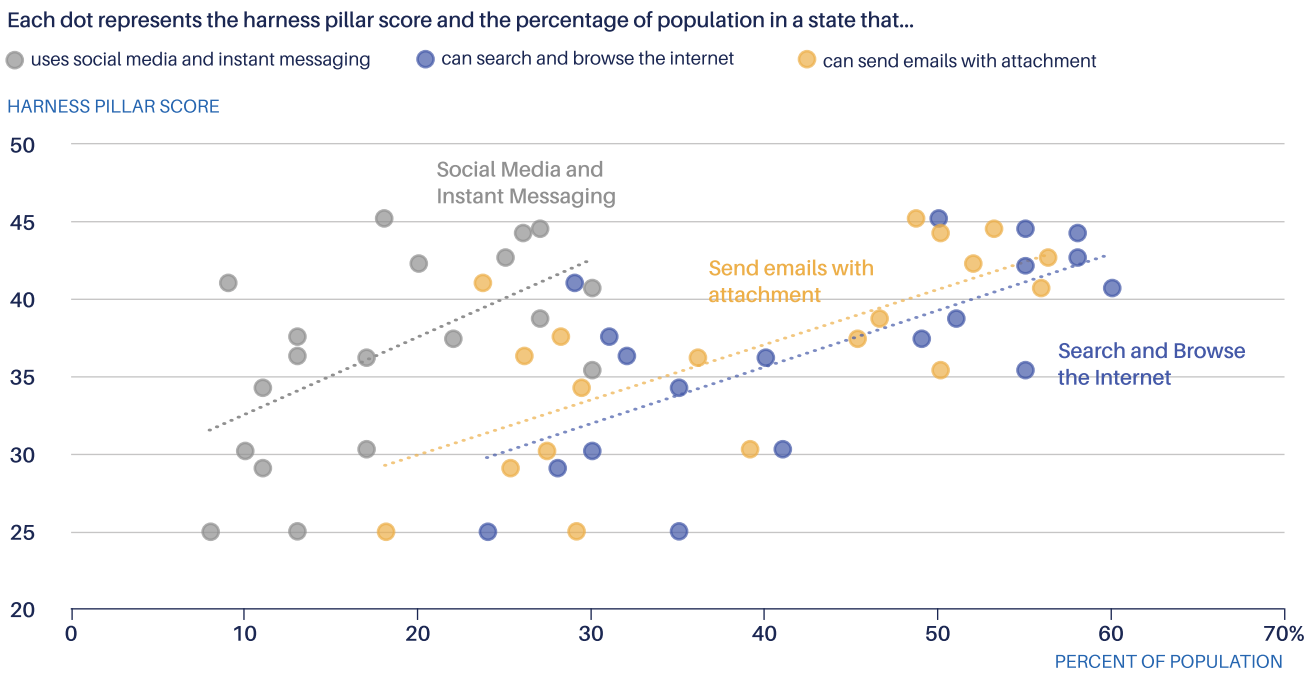
As discussed above, while coverage of internet infrastructure is improving rapidly, infrastructure by itself is not reducing the usage gap which is defined as the share of population that lives within the reach of a mobile network but does not use it. The usage gap is particularly high for India, estimated at 41 per cent in 2022.[68] The reasons for high usage gap include poor affordability, lack of digital literacy, and perceived lack of relevance among digitally unconnected people.

Digital literacy is positively correlated to the population's ability to harness the digital economy (see Figure 36). In 2020, about 43 per cent of the population were estimated to be able to search or browse the internet; 39 per cent were able to use social media and instant messaging. More advanced functions such as sending emails with attachments were less common (19 per cent according to Kantar ICUBE, 2020 and 16 per cent according to NSS MIS, 2020-21). The ability to use more advanced computer-based applications such as spreadsheets, electronic presentations and programming languages were very rare (see Annexure 8).

68 Okeleke, K. & Suardi, S. (2022, March). *The Mobile Economy 2022*. GSMA Intelligence.

FIGURE 36

Positive correlation between digital literacy and harnessing abilities



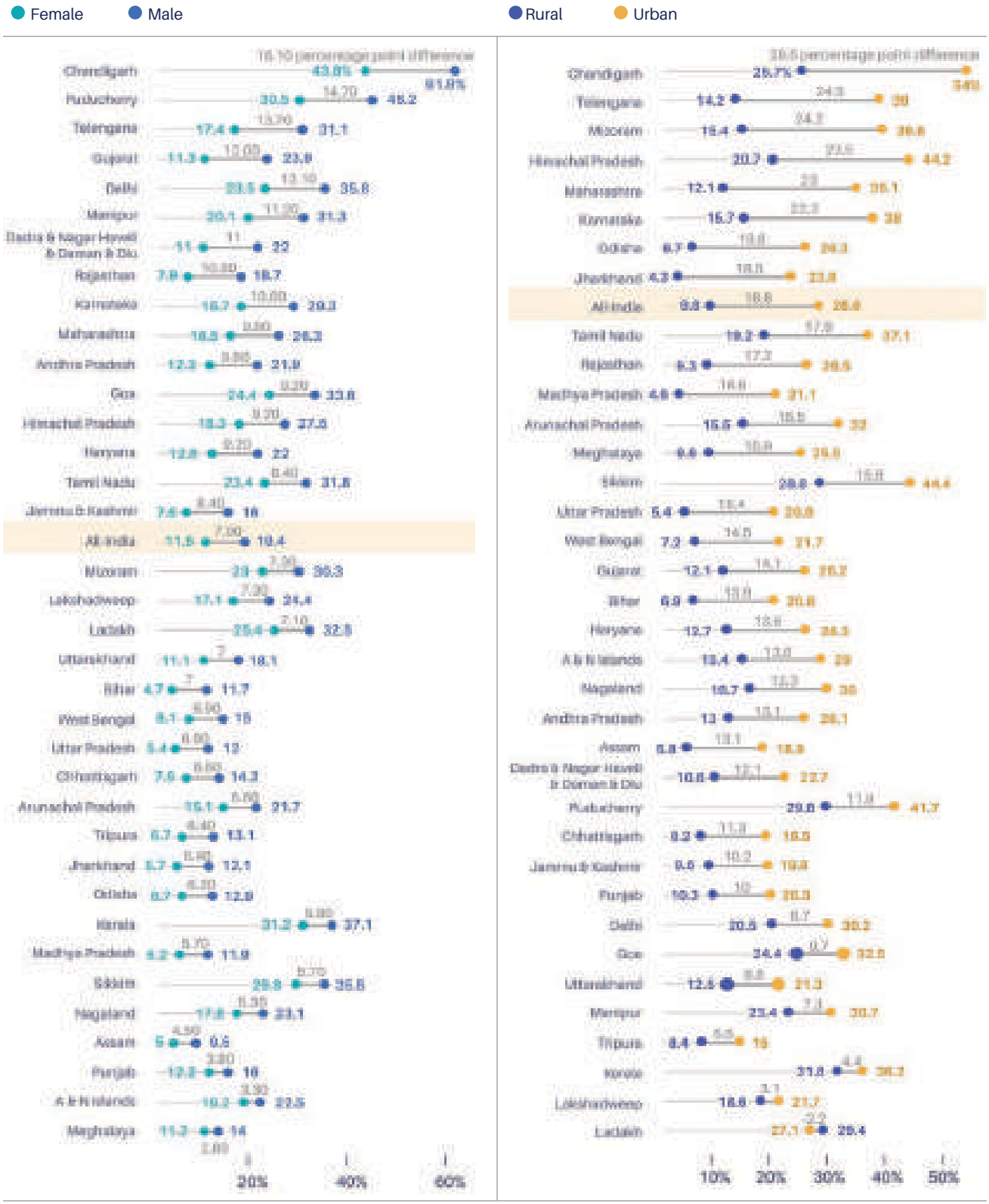
Source: IPCIDE Research and IMRB 2020

Moreover, there exists a divide in the digital literacy of men and women, which further exacerbate the access gap. Usually, states with higher gender divides in digital literacy also tend to have higher urban-rural divides, with the latter being larger than the former. However, Mizoram, Himachal Pradesh, Odisha, Jharkhand, Madhya Pradesh, and Meghalaya are some states and UTs with relatively low gender gaps but high urban-rural gaps (see Figure 37).

FIGURE 37

Digital Divides in Literacy

Per cent able to send email with an attachment



Source: IPCIDE Research

Innovate

Need to broaden the base

The top-ranking states for the innovate pillar align well with the outcome of the India Innovation Index 2021, though the latter is a much broader measurement of innovation capturing not only enablers (output) of innovation but also performance (output). The state scores reflect complementarity in knowledge production and business innovation, i.e., the two are positively correlated. Knowledge production indicators are not only indicative of research capabilities but also skill availability. In fact, states with higher business innovation scores also have high start-up and investment scores that collectively reflect the business environment of the states. Not surprisingly, states with high business innovation scores also receive the highest FDI (see Figure 38).

TABLE 7

Ranks and scores for the Innovate pillar

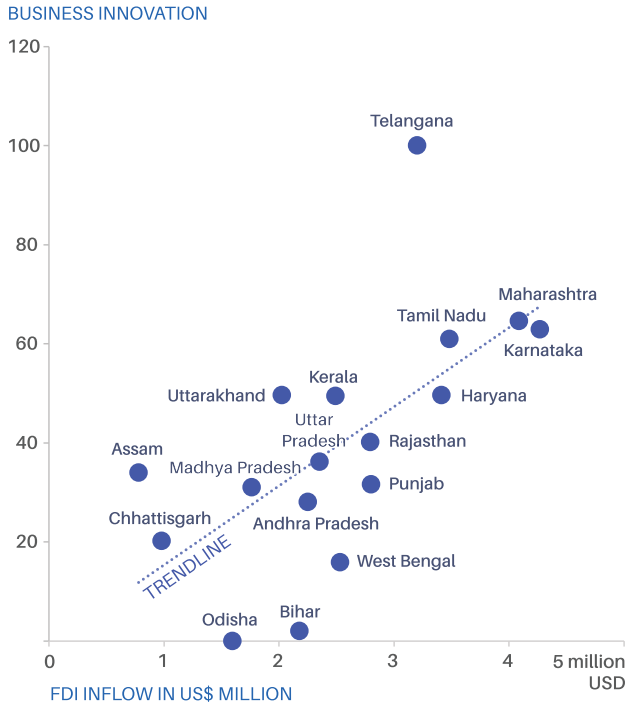
Large States (population > 1 crore)			UTs and Small States (population < 1 crore)*	
Rank	Name	Score	Name	Score
1	Karnataka	61.4	Delhi	54.8
2	Maharashtra	59.4	Chandigarh	32.2
3	Telangana	51.3	Goa	23.1
4	Tamil Nadu	45.0	Himachal Pradesh	22.1
5	Haryana	33.6	J&K	12.9
6	Kerala	32.1	Tripura	6.2
7	Gujarat	31.7	Arunachal Pradesh	5.1
8	Uttar Pradesh	28.1		
9	Andhra Pradesh	21.5		
10	Rajasthan	20.6		
11	Uttarakhand	20.4		
12	Punjab	16.8		
13	Madhya Pradesh	16.4		
14	Assam	14.4		
15	Chhattisgarh	11.0		
16	West Bengal	11.0		
17	Jharkhand	8.6		
18	Odisha	5.2		

Rank	Name	Score	Name	Score
19	Bihar	4.2		

Ranking within groups: Large States (population > 1 crore) and UTs and Small States (population < 1 crore), while the scores are standardised across the combined sample.
**Sikkim and Many UTs have not been ranked due to unavailability of data for several indicators*

FIGURE 38

Innovation in Business-Friendly Environments



Source: IPCIDE Research and PIB March 2022
Note: Gujarat is missing from this graph as data for all indicators of business innovation were not available

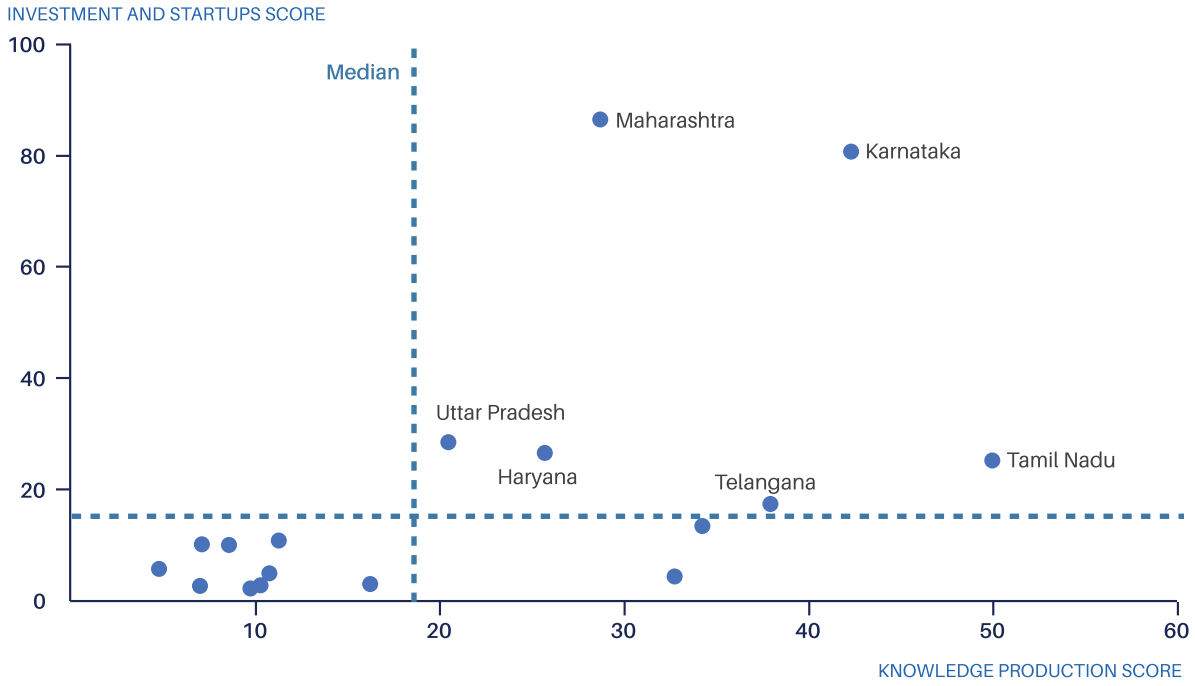
Both knowledge production and knowledge use (depicted by the business innovation score and investment and start-ups) are concentrated in a few states – Uttar Pradesh, Haryana, Telangana, Tamil Nadu, Maharashtra and Karnataka have high investment in start-ups and high knowledge production (see Figure 39). For business innovation the set is narrower and includes only Telangana, Tamil Nadu, Karnataka and Maharashtra. For most UTs and small states, data on innovation indicators are not available, reflecting poor or non-existent levels of innovation activity. Besides geographical concentration, adoption of AI and emerging technologies are also concentrated in a few sectors. These include travel and hospitality, technology, media and telecommunication (TMT), financial services, healthcare and pharmaceuticals.[69]

State governments have played an important role in building their innovation capabilities. Many state governments including Tamil Nadu, Karnataka, Kerala and Telangana that score well on the innovate pillar have emerging technology departments that create capacity within government to develop and harness new technologies as well as partner with private sector to deploy new technologies. The central government can play an important role in helping broad-base innovation, as it already does through its initiatives on building Centres of Excellence and AI innovation hubs. The government has also established Centres of Entrepreneurship such as OCTANE – a group of eight internetworked Centres of Entrepreneurship (CoEs) in the North East region. These initiatives can help spur innovation activity across the country.

69 Consultancy.in. (2023, June 30). *Indian enterprises increasing their adoption of AI and ML*

FIGURE 39

Concentration in Innovation



Source: IPCIDE Research

Protect

Growing threats from India's digital underbelly

The more digitalised the state, the higher is its vulnerability to cyberattacks. The most recent cyber threat report published by the Data Security Council of India identifies malware as the single most security threat to India's rapidly digitalising economy.[70] States with the highest malware detections include Telangana, Tamil Nadu, Delhi, Gujarat, Karnataka, Maharashtra and Haryana, in that order. We see a negative correlation between the CHIP score and cybercrime reporting across states and UTs in India (see Figure 40).[71] This is possibly because more digitalised states are more vulnerable to cybercrimes (as they are also the richer states) as well as because states with advanced levels of digitalisation also report more crimes.

TABLE 8

Ranks and scores for the Protect pillar

	Large States (population > 1 crore)		UTs and Small States (population < 1 crore)	
Rank	**Name**	**Score**	**Name**	**Score**
1	Rajasthan	69.7	Ladakh	75.0
2	Karnataka	67.2	Lakshadweep	75.0
3	Gujarat	67.0	Mizoram	75.0
4	Chhattisgarh	65.7	Nagaland	74.9
5	Haryana	64.7	Tripura	74.5
6	Kerala	62.0	Arunachal Pradesh	72.6
6	Assam	62.0	J&K	72.4
8	Madhya Pradesh	61.2	Manipur	71.7
9	Uttarakhand	61.1	Meghalaya	71.2
10	West Bengal	59.8	Sikkim	70.9
11	Odisha	59.7	Chandigarh	69.4
12	Uttar Pradesh	59.3	Delhi	69.3
13	Bihar	58.3	Himachal Pradesh	67.9
14	Jharkhand	54.7	Andaman & Nicobar Islands	62.2
15	Andhra Pradesh	54.4	Dadra & Nagar Haveli, Daman & Diu	61.2
16	Punjab	53.5	Goa	55.3

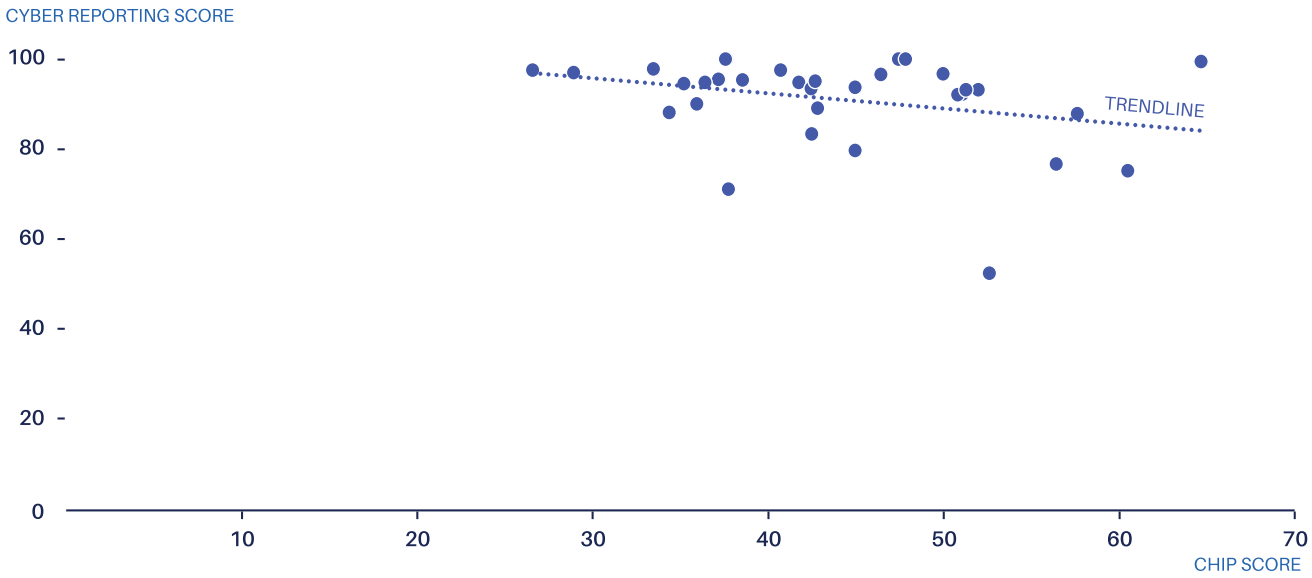
70 Data Security Council of India (DSCI). (2023). *India Cyber Threat Report 2023.*
71 Ibid

Rank	Name	Score	Name	Score
17	Telangana	53.1		
18	Tamil Nadu	50.9		
19	Maharashtra	44.7		

Ranking within the groups: Large States (population > 1 crore) and UTs and Small States (population < 1 crore), while the scores are standardised across the combined sample.

FIGURE 40

States with higher CHIP Scores report higher cybercrime (lower cyber reporting score)



Source: IPCIDE Research and Cyberthreat report, Data Security Council of India

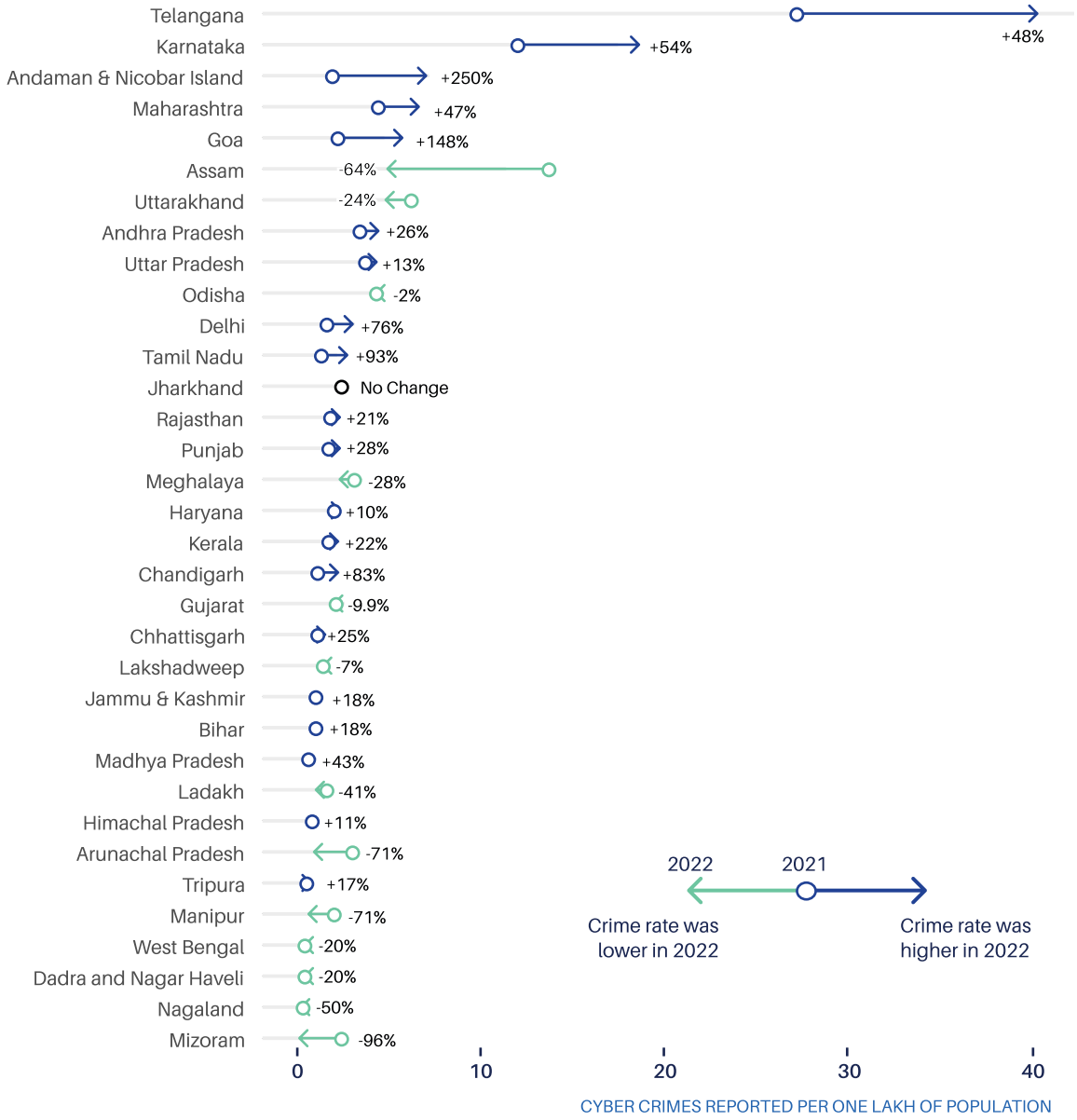
According to reports from the National Crime Bureau (NCRB), cybercrimes have increased by more than 50 per cent between 2021 and 2022 in states like Goa, Assam, Tamil Nadu, Maharashtra and Delhi (see Figure 41). Many smaller states and UTs reported fewer crimes in 2022 as compared to 2021 (negative growth rates).

The Future Crime Research Foundation's 2023 report on cybercrime trends in India state that online financial frauds are the most common form of cybercrime in India. In a distribution across online and social media related crime, hacking/damage to computer and other cybercrimes, online financial frauds comprised almost 77.5 per cent of all cybercrimes. It also identifies ten areas that are the epicentres of cybercrimes, accounting for 80 per cent of the reported crimes. These are Bharatpur, Mathura, Nuh, Deoghar, Jamtara, Gurgaon, Alwar, Bokaro, Karma Tand and Giridih. As highlighted in their report, these are districts with proximity to urban areas, socio-economic challenges, low digital literacy, and possibly high youth unemployment or underemployment rates. These epicentres do not map one to one with the data reported by NCRB and mostly belong to the north and eastern regions of India (see Figure 42). However, the report also lists out several new emerging cybercrime hotspots that are spread across many more states cutting across the nation.[72] As a response, cyber budgets are increasing across

72 Ibid

FIGURE 41

Most larger states see a bigger jump in cybercrime reporting



Source: NCRB 2021 and 2022

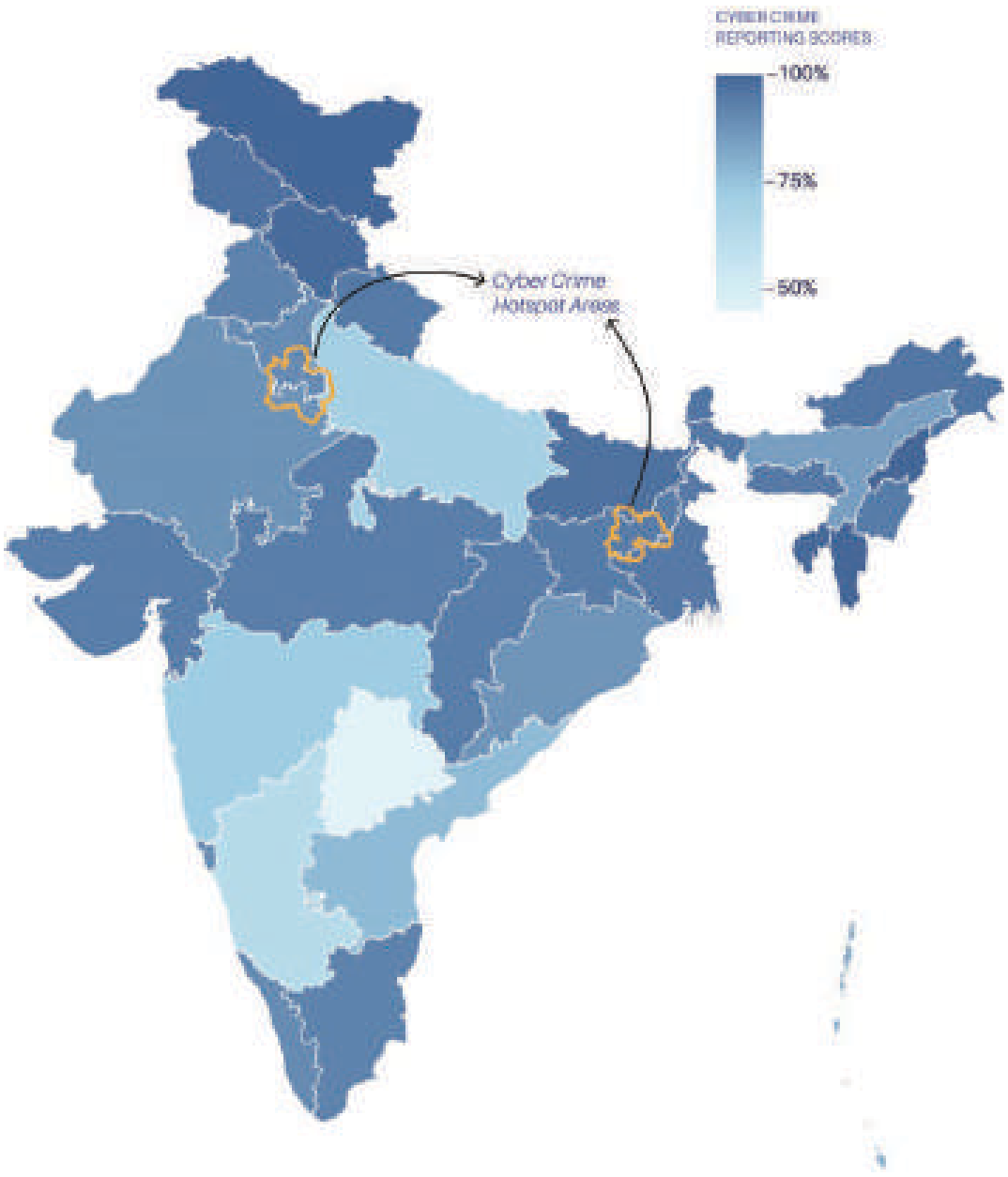
industries. According to a PwC Survey, 99 per cent of the respondents stated an increase in cyber budgets, out of which 50 per cent of them envisaged an increase of 6 to 15 per cent in the next 12 months.[73] According to Ernst & Young's India Data Protection Readiness Report, 32 per cent of organisations foresee technical implementation challenges, while 50 per cent are yet to acquire relevant skills and are open to outsourcing data privacy tasks to implement the new Digital Personal Data Protection Act.[74] Rising cybercrimes both domestically and internationally need serious attention both from the perspective of building stronger infrastructure and improving awareness among users.

73 PwC. (2024). *The C-suite playbook: Putting security at the epicentre of Innovation.*

74 EY India. (2023, October 29). *EY survey reveals that 50% of the surveyed organizations are yet to acquire the required skill sets to implement DPDP Act.*

FIGURE 42

Cybercrime hotspots in India



Source: NCRB and FCRF, 2023

Spotlight on India's DPI-led digitalisation

India's digitalisation is on a path that is less travelled by other G20 countries. Home to some of the biggest tech companies in the world - Microsoft, Amazon, Tesla, Apple, Amazon, Netflix and Alphabet - the US's digitalisation has been largely led by the private sector.[75] On the other hand, the government holds the commanding position in China's digitalisation journey, where lines between public and private ownership are blurred. With the India Stack - Aadhaar (identity layer), UPI (payments layer) and Account Aggregators (data layer) - India has chosen the Digital Public Infrastructure (DPI) approach, distinct for embracing open standards, interoperability and public-private partnerships. Endorsed by G20 during India's Presidency, DPI-led digitalisation has now found global acceptability.

The G20 defined DPI as "a set of shared digital systems which are secure and interoperable, built on open standards and specifications to deliver and provide equitable access to public/private services at societal scale and are governed by enabling rules to drive development, inclusion, innovation, trust, and competition and respect human rights and fundamental freedoms".[76] While DPI is an evolving concept, the technological design is characterised by interoperability, modularity and extensibility, scalability, security and privacy".[77]

India's DPI approach has created digital railroads to scale and improve public service delivery. India boasts of the second largest network of digital IDs, following China. Launched seven years after China and alongside the digital ID program in Indonesia, Germany, and Russia, India enrolled 1.4 billion citizens with a current enrolment rate of 94 per cent (see Figure 43).

Digital Identity and Distribution of Welfare Services

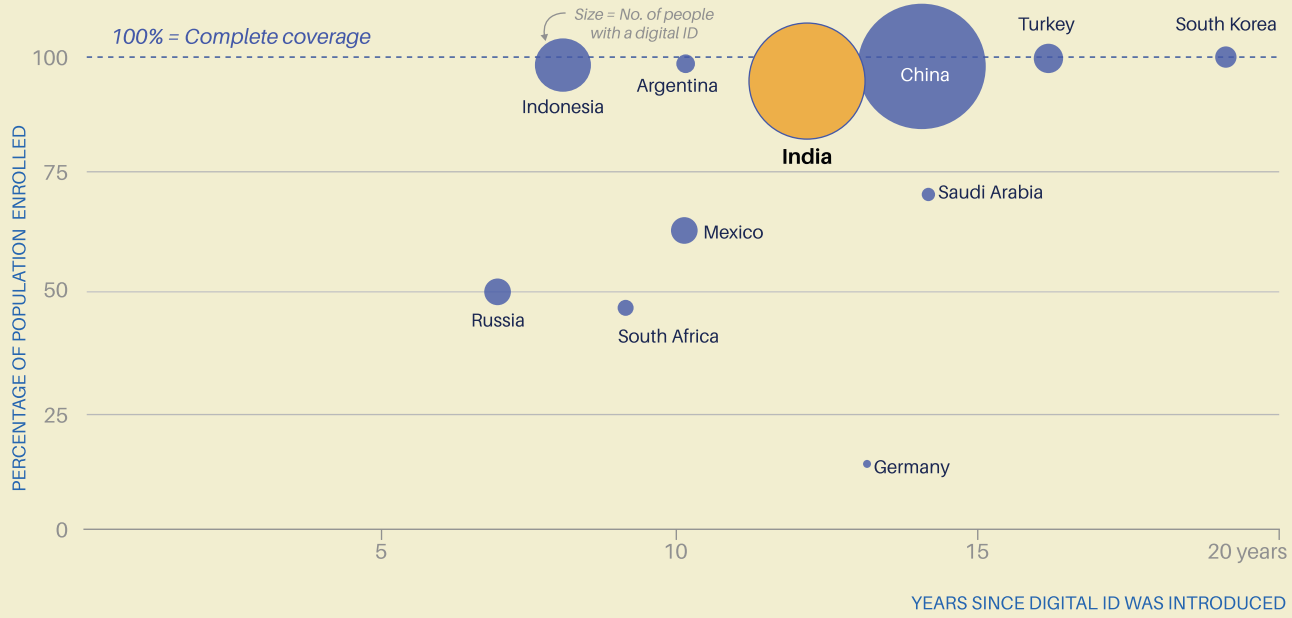
The use of Aadhar has led to considerable benefits in delivery of welfare, though it has also given rise to new challenges. Aadhar backed authentication and e-KYC are steadily rising in India (see Figure 44). In her latest budget speech, the finance minister announced that the Aadhar-enabled direct benefit transfer system led to a saving of Rs. 2.7 lakh crore, when disbursing benefits worth Rs. 34 lakh crores. These savings have been redeployed into the government's *Garib Kalyan* program.[78] With the rising centrality of Aadhaar in proving identity for access to public services, critics have pointed to the rising risks of exclusion. For instance, a 2024 study published in the Economic & Political Weekly which surveyed around 3,000 MGNREGS workers across eight villages in Jharkhand found that 57 percent of the deleted job cards belonged to genuine workers. The research also found that while Aadhaar-linking had decreased errors of inclusion by 16.8 percent, it had also led to a corresponding increase in exclusion errors by 22.4 percent.[79] The Hindu reported that 34.8 per cent registered workers and 12.7 per cent active workers would not be eligible once Aadhaar linked payments become mandatory for MGNREGS workers.[80] Reportedly, these are driven by problems in

75 *For a dissenting argument, see Faroohar, R. (2015, October 27). Why You Can Thank the Government for Your iPhone. Time.*
76 G20 2023. (2023, August 19). *G20 Digital Economy Ministers Meeting Outcome Document and Chair Summary. G7 G20 Documents Database.*
77 G20 2023 & UNDP. (2023, August 21). *The DPI Approach – A Playbook.* UNDP.
78 Government of India. (2024, February 1). *Interim Budget 2024-25. Speech of Nirmala Seetharaman. Minister of Finance.*
79 Bhaskar, A., Sarkar, A. & Singh, P. (2024, January 06). *To Link or Not to Link: How Aadhaar Impacts the Delivery of Welfare. Economic & Political Weekly.*
80 Nair, S K. (December 31, 2023). *Aadhaar-linked pay becomes mandatory for MGNREGS workers. The Hindu.*

implementation. Further, given the increasing reliance and linking of various programs to Aadhaar, efforts to improve coverage in areas where enrolment levels are relatively low, such as the North-Eastern states, must be accelerated (see Figure 45 for state-wise enrolment of Aadhaar).

FIGURE 43

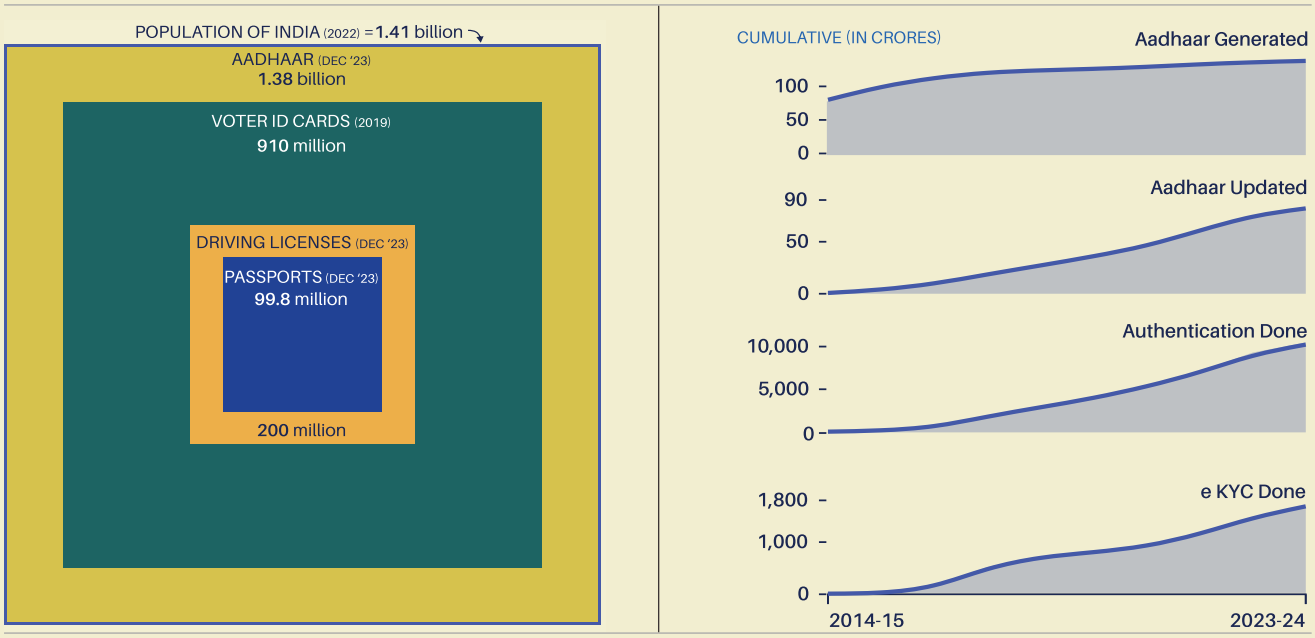
India's digital ID program, the second largest in the world, saw rapid roll-out



Source: World Bank ID4D database, World Bank, IPCIDE research

FIGURE 44

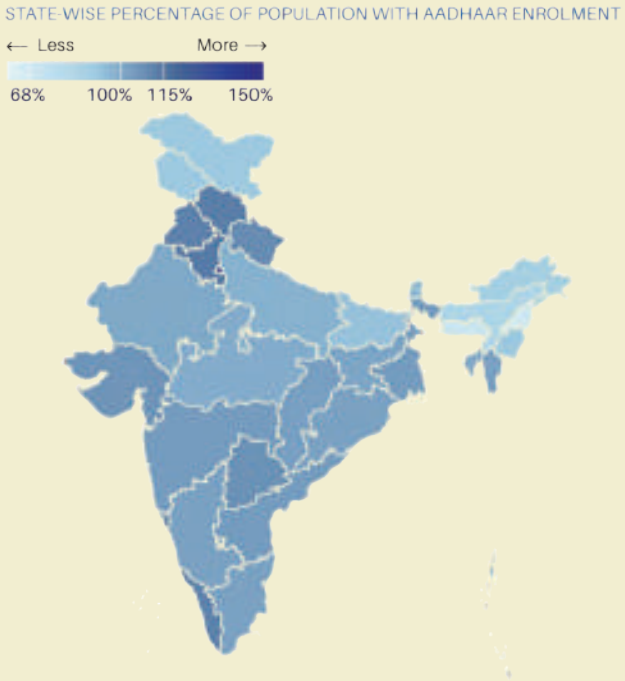
India's Aadhar and Aadhaar-enabled ecosystem continues to expand



Source: MEA Dashboard, UIDAI dashboard, Parivahan Sarathi Dashboard, World Bank (https://data.worldbank.org/indicator/SP.POP.TOTL?locations=IN) and International IDEA (https://www.idea.int/data-tools/data/country?country=103&database_theme=293) | Source: MeitY dashboard

FIGURE 45

State-wise percentage of population with Aadhaar Enrolment



Source: UIDAI dashboard (as on 9 Jan 2024)

Digital Financial Inclusion

The well-established UPI stands as the cornerstone of India's digital payments ecosystem. As reported in the main text, UPI reported a volume of 117 billion transactions amounting to Rs. 182 trillion in 2023. 81 The number of digital payment users were higher than all other G20 countries, with the exception of China. India was also among the early adopters of fast digital payments, only after UK in 2008, China in 2010 and South Korea in 2014 (see Figure 46).

The Account Aggregators (AAs) ecosystem, operating in the consent layer of the India stack have also expanded in use and coverage. Between 2022 and 2023, the number of financial information providers increased from 29 to 146, financial information users from 128 to 363, number of accounts linked from 3.2 million to 38.96 million and number of successful data sharing instances from 3.3 million to 40.1 million.[82]

DPIs have accelerated financial inclusion in India through several channels. *Aadhaar* and the *Jan-Dhan* Scheme (PMJDY) have been key triggers for this acceleration. Migrant workers have found new avenues of sending remittances through money transfer agents and UPI, as opposed to the earlier practice of carrying cash themselves or sending it through fellow villagers.[83] For financial inclusion and social protection of unorganised workers, the government has introduced the Aadhaar-linked e-Shram portal. Launched in August 2021, e-Shram is a National Database of Unorganised Workers (NDUW) aged between 16-59. As of December 2023, there were over 290 million registrations, though varying significantly by state (see Figure 47).

The rapid progress of DPIs have also coincided with a deceleration in opening of new bank branches in the last decade (See Figure 48).

Besides, massive growth in digital payments, the last-mile network of banking correspondents (BCs), creation of state common service centres (CSCs) and digitalisation of banking services may have collectively contributed to the changing landscape.

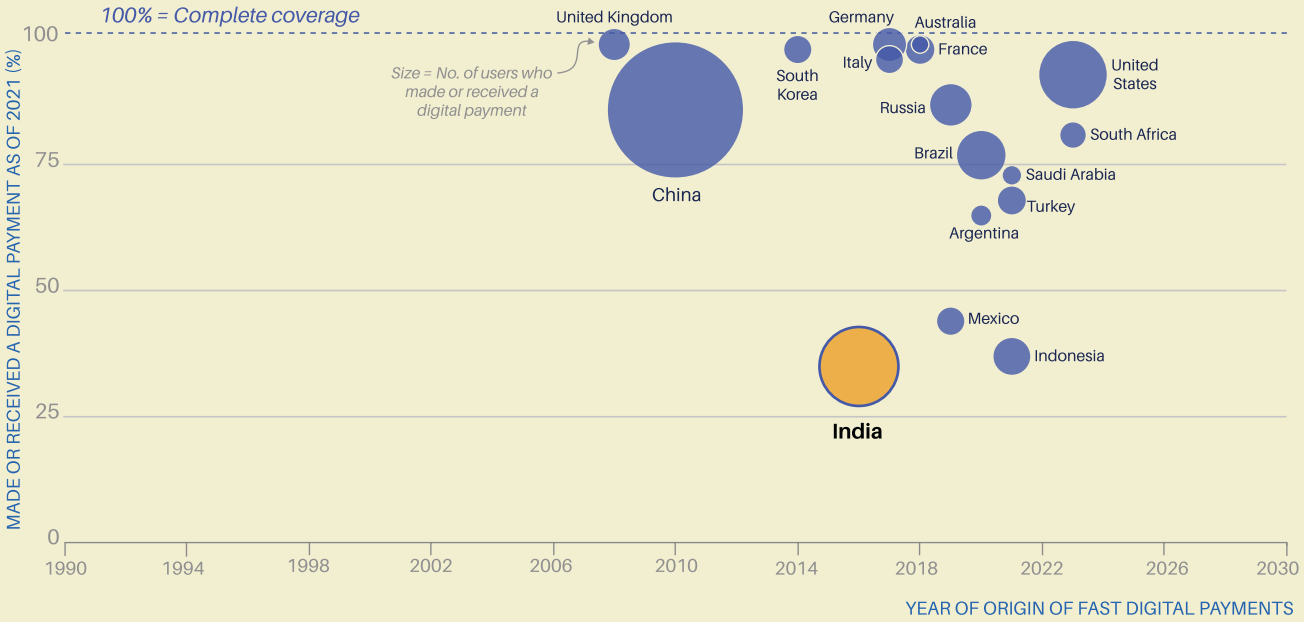
Whole of Government Approach to Digitalisation

India is building the Ayushman Bharat Digital Mission (ABDM) using the DPI rails of the Ayushman Bharat Health Account (ABHA) or a Health ID, health registries for data exchange and a unified health platform (UHI). In general, India is working towards a whole-of-government approach for digital service delivery using DPIs at its foundation. This also includes taxation (GSTN and IT portal), public procurement (GeM), social protection (e-Shram), education (DIKSHA), vaccination (Co-win), transportation (Parivahan and Sarathi) and document management (digilocker). More than 4,200 e-government services are provided across the country, recording 160 billion e-transactions in 2023-24.[84]

81 National Payments Corporation of India. (n.d.).
82 Sahamati. (January 09, 2024). *Growth of the AA Ecosystem 2023.*
83 Arunachalam, R S. (2023, December). *Inclusive Finance India Report 2023.* Access Publication.
84 Ministry of Electronics and Information Technology, Government of India. (n.d.). *e Taal Dashboard.*

FIGURE 46

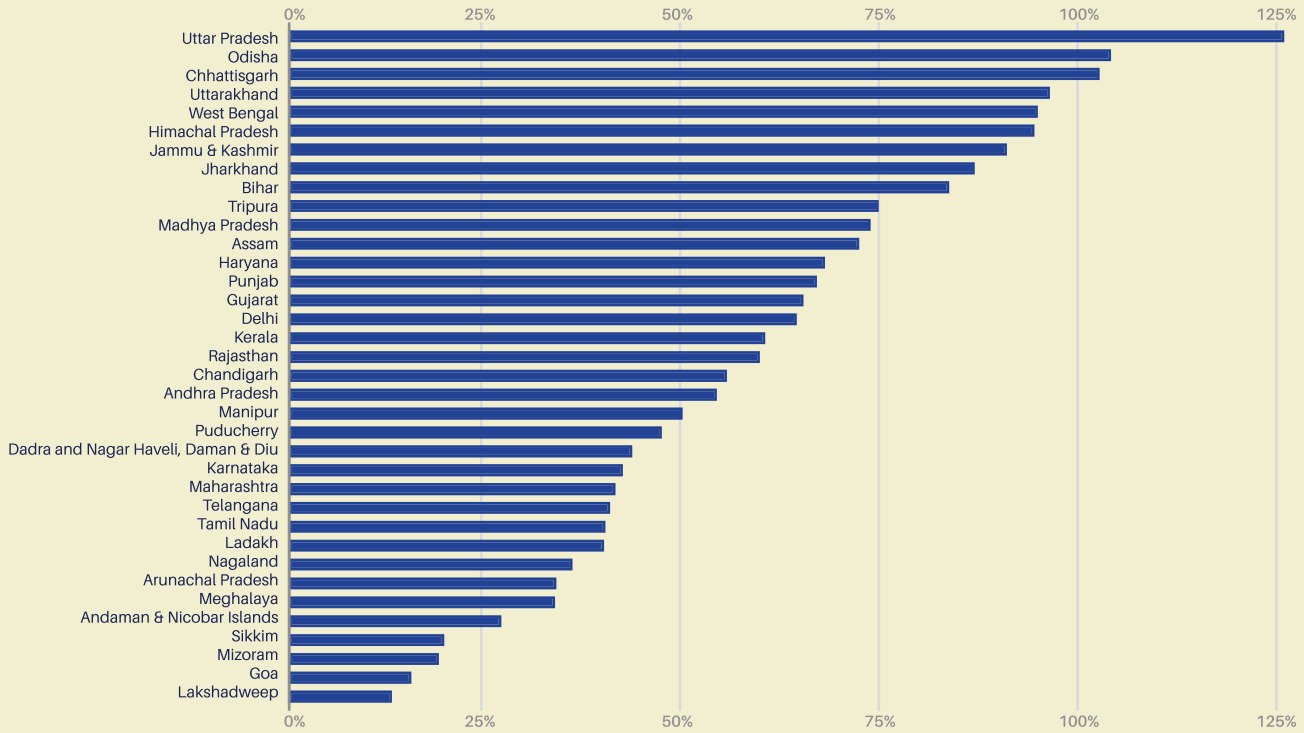
India has achieved rapid scale in digital payments



Source Findex and NPCI, IPCIDE research
Note:Number of digital payment users refers to the types of digital payments

FIGURE 47

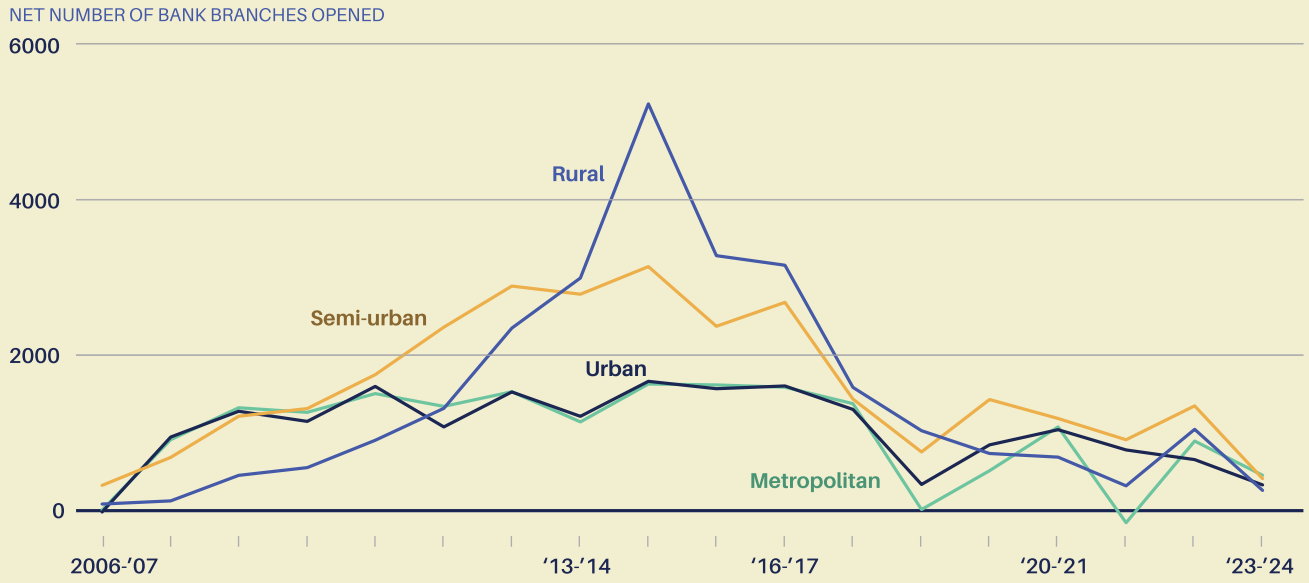
Percent of state-wise eShram registration targets accomplished



Source: Lok Sabha unstarred question 2353 (2023)
Note: Targets for registrations on the e-shram portal are based on estimates of informal employment from the PLFS 2017-18 which are underestimates of current number of individuals employed informally.

FIGURE 48

Rapid growth of digital payments has been associated with fewer opening of new bank branches



Source: RBI data 2006-23

While rapid digitalisation has been associated with tremendous benefits, it has also made institutions and users vulnerable to risks of privacy breaches and other cyber-related financial crimes. The DPI approach is defined by three key pillars – (i) open, interoperable technology, (ii) robust governance, and (iii) resilient local systems.[85] While the first has been templatised in all applications in India, the latter two need greater attention - building complementary regulatory institutions and communities of practices that involve the participation of private sector, civil society and academia, will be important to build safe, inclusive and secure delivery mechanisms.

For example, while UPI is the largest real-time payment system in the world with over 89.5 billion transactions in 2022, surveys find that among the G20 countries, India has the highest payments fraud rate – 45 percent of the sampled population reported being a victim of a payment fraud in the last 4 years.[86] UPI constitutes 47 per cent of all cybercrime and 61 per cent of all online financial frauds in India.[87] According to RBI's Trend and Progress of Banking in India (2023), reported internet and card frauds (of Rs. 1 lakh and above) increased from 1,191 instances amounting to Rs.40 crores in 2015-16 to 3,596 instances amounting to Rs.155 crore.[88] The absence of an effective grievance redressal mechanism and reduced trust can constrain the uptake of UPI. Additionally, as highlighted in other sections of this report, connectivity infrastructure needs to be strengthened to minimise frictions in the provisioning of essential services. Building effective guardrails and a strong analogue backbone is going to be crucial to harness the true potential of DPI-led digitalisation in India.

85 G20 2023 & UNDP. (2023, August 21). *The DPI Approach – A Playbook*. UNDP.
86 ACI Worldwide. (2023*). 2023 Prime Time for Real-Time Report.*
87 Future Crime Research Foundation (FCRF). (2023). A Deep Dive into Cybercrime Trends Impacting India.
88 Reserve Bank of India. (2023, December 27). *Report on Trend and Progress of Banking in India 2022-23.*

What to expect in SIDE 2025

Digitalisation has made dramatic progress, but the way it is being measured has not. Therefore, the State of India's Digital Economy (SIDE) report was designed from the very beginning to be a living document, to be improved, tweaked and renewed every year. We introduced the CHIP framework in 2023, as an evolving effort to measure digitalisation using a framework that recognises alternate approaches adopted by developing countries The framework was expanded to become CHIPS in 2024. We also brought more rigour and objectivity to the 2024 version by creating a three-tier framework, consisting of five pillars, 16 sub-pillars, and 15 indicators. In the 2025 edition, we hope to strengthen and universalise CHIPS through the following:

Expand the coverage to non-G20 countries, including other developed and developing countries that have shown or hold great promise on digitalisation, such as Chile, Estonia, Kenya, Singapore, Netherlands, Philippines and Vietnam.

Combine appropriately key aspects of CHIPS (Economy) and CHIPS (User) to present a single index that conveys the mix of unique successes and challenges which developing countries are faced with in their digitalisation journey.

Genderise the index by including more data focusing on women. The concerns of gender divide in digital access and adoption are a primary concern, more so in developing countries where divides are accentuated by existing socio-economic conditions.

Strengthen measurement of the Protect and Sustainability Pillars. New data on privacy and protection, adoption of green technologies and online safety of women and children needs to be added to the index.

Harmonise the cross-country and subnational CHIPS to allow for a direct comparison between states and UTs in India with countries in the rest of the world.

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Annexures

Annexure I: CHIPS Framework and Methodology (Cross Country)

The CHIP framework was conceptualised in 2022 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 CHIP framework assessed indicators that were both outcomes and enablers/ inputs of the digital economy.

This second edition of the State of India's Digital Economy report has expanded the framework to include a fifth pillar of sustainability, i.e., CHIP has 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. This year's report also distinguishes outcomes from enablers – the index only includes outcomes. 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.

Methodological Framework:

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 are comprised of similar indicators, but the latter is normalized by the relevant unit (e.g., population, number of internet users, GDP, etc.). A total of **50 indicators** are grouped into **16 sub-pillars**, which are then categorised under the **5 pillars** of CHIPS.

Normalising values for all indicators:
As is standard practice, each indicator is first standardised using the following formula:

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

This standardises 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 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:

$$\text{Inverted standardised value} = \left(\frac{Max - Value}{Max - Min}\right) \times 100.$$

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.

Weights:

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. 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 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 comprised of a set of sub-pillars that contribute equally.

Aggregation from indicator to sub-pillar:

$$\sum_{i=1}^{n} (w_i \times v_{im}) \text{ such that } \sum_{i=1}^{n} w_i = 1$$

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 below:

CHIPS (Economy) – Indicators & Weights

Pillar	Sub-pillar	Sl. No.	Indicator	Weight within sub-pillar
CONNECT	Affordability	1	Price of mobile data and voice basket (High Consumption)	1/4
		2	Price of mobile data and voice basket (Low Consumption)	1/4
		3	Price of cheapest smartphone in USD	1/4
		4	Price of fixed broadband internet in USD	1/4
	Quality	5	Median Mobile Download Speeds (Mbps)	1/2
		6	Median Fixed Broadband Download Speeds (Mbps)	1/2
	Access	7	Number of internet users	1/5
		8	Mobile cellular subscriptions	1/5
		9	Population covered by LTE	1/5
		10	Number of smart phone users	1/5
		11	Gender gap in % of population using the internet[1]	1/5
HARNESS	Apps and Platforms	12	Number (16-64 years) using social media for work related activities	1/5
		13	Number of users of digital food delivery platforms	1/5
		14	Number of users of digital health applications	1/5
		15	E-commerce users	1/5
		16	Number of mobile of app downloads (in billions)	1/5
		17	Video On Demand Users	1/5
	Data Intensity	18	Total monthly fixed broadband internet traffic (TB)	1/2
		19	Total monthly mobile broadband internet traffic (TB)	1/2

1 Calculated as the difference between % of male population using the internet and % of female population using the internet, divided by % of total population using the internet.

HARNESS	**Financial Services**	20	Value of digital payment transactions in billions of dollars	1/4
		21	Number of people who made or received a digital payment	1/4
		22	Number of people (age 15+) who received private sector wages into an account	1/4
		23	Neo banking Transaction value (USD)	1/4
	Public Sector (payments)	24	Number of people who received public sector wages: into an account (age 15+)	1/2
		25	Individuals who received government transfer or pension into an account	1/2
	Real Economy	26	ICT service exports (BOP) (millions of current USD)	1/2
		27	ICT Value Added (billions of USD)	1/2
INNOVATE	**Artificial Intelligence**	28	No. of AI Publications	1/3
		29	Contributions to Global AI Projects (%)	1/3
		30	Venture Capital Investments in AI (millions of USD)	1/3
	Investment and Startups	31	No. of start -ups	1/2
		32	Valuation of Unicorns (billions of USD)	1/2
	Emerging Tech	33	Consumer IoT Revenues (millions of USD)	1/4
		34	AR/VR Revenues (millions of USD)	1/4
		35	Metaverse Revenues (millions of USD)	1/4
		36	DeFi Revenue (millions of USD)	1/4
PROTECT	**Preparedness**	37	Cybersecurity spending (millions of USD)	1/3
		38	No. of cybersecurity patents (cumulative 2018-2022)	1/3
		39	No. of Secure servers	1/3
	Cyber Attacks	40	No. of ransomware attacks (30-day average)	1/2
		41	No. of email leaks (quarterly average 2020 Q3- 2023 Q3)	1/2
	Trust	42	Per cent of respondents who are somewhat concerned about online privacy	1/2
		43	Per cent of respondents who say they trust the internet	1/2
SUSTAINABILITY	**Green Digital Tech**	44	Market revenue from green data centres (millions of USD)	1/5
		45	Market revenue from Environment, Health, and Safety (EHS) software including carbon footprint management (millions of USD)	1/5
		46	Market revenue from Energy Management Software	1/5
		47	Market revenue from Sustainable Electronics (Smartphones and PCs)	1/5
		48	E-waste generation in kilo tonnes	1/5
	Green R&D	49	No. of Patents filed in Smart Grids (2000-2021)	1/2
		50	No. of Patents filed in Information/Communication Technologies for Electromobility (2000-2021)	1/2

CHIPS (User) – Indicators & Weights

Pillar	Sub-pillar	Sl. No.	Indicator	Weight within sub-pillar
CONNECT	Affordability	1	Price of mobile data and voice basket (High Consumption) as a % of GNI per capita	1/4
		2	Price of mobile data and voice basket (Low Consumption) as a % of GNI per capita	1/4
		3	Price of cheapest smartphone in USD as a % of average monthly income	1/4
		4	Price of fixed broadband internet in USD (PPP adjusted)	1/4
	Quality	5	Median Mobile Download Speeds (Mbps)	1/2
		6	Median Fixed Broadband Download Speeds (Mbps)	1/2
	Access	7	Percent of population using the internet	1/5
		8	Mobile cellular subscriptions per 100 people	1/5
		9	Per cent of population covered by LTE	1/5
		10	Per cent of population using a smart phone	1/5
		11	Gender gap in per cent of population using the internet[1]	1/5
HARNESS	Apps and Platforms	12	Per cent of internet users (16-64 years) using social media for work related activities	1/5
		13	Per cent of internet users using digital food delivery platforms	1/5
		14	Per cent of internet users using digital health applications	1/5
		15	Per cent of internet users doing ecommerce	1/5
		16	No. of mobile app downloads per internet user	1/5
		17	Video On Demand Users as a % of internet users	1/5
	Data Intensity	18	Average monthly mobile broadband internet traffic per mobile broadband subscription (MB)	1/2
		19	Average monthly fixed broadband internet traffic per fixed broadband subscription (MB)	1/2
	Financial Services	20	Value of digital payment transactions (PPP adjusted) per internet user	1/4
		21	Per cent of internet users who made or received a digital payment	1/4
		22	Per cent of people (age 15+) who received private sector wages into an account	1/4
		23	Neo banking Transaction value per internet user (USD) (PPP adjusted)	1/4
	Public Sector (payments)	24	Per cent of public sector wage recipients (age 15+) who received public sector wages into an account	1/2
		25	Per cent of government transfer or pension recipients (age 15+) who received a transfer into an account	1/2

1 Calculated as the difference between % of male population using the internet and % of female population using the internet, divided by % of total population using the internet.

HARNESS	Real Economy	26	ICT service exports as a % of service exports (BoP)	1/2
		27	ICT Value-added as a % of GDP	1/2
INNOVATE	Artificial Intelligence	28	No. of AI publications as a % of all publications	1/3
		29	Contributions to Github AI Projects (%)	1/3
		30	VC Investments in AI as a % of Investments (GFCF[2])	1/3
	Investments and Startups	31	No. of Startups per billion USD ICT value-added	1/2
		32	Valuation of Unicorns per USD of Stock Market Valuation	1/2
	Emerging Tech	33	Consumer IoT Revenues (millions of USD) (PPP adjusted) per internet user	1/4
		34	AR/VR Revenues (millions of USD) (PPP adjusted) per smartphone user	1/4
		35	Metaverse Revenues (millions of USD) (PPP adjusted) per smartphone user	1/4
		36	DeFi Revenue (millions of USD) (PPP adjusted) per internet user	1/4
PROTECT	Preparedness	37	Cybersecurity spending (millions of USD) (PPP adjusted) per user	1/3
		38	Per cent of total patents that are cybersecurity related (cumulative 2018-2022)	1/3
		39	No. of Secure servers per internet user	1/3
	Cyber Attacks	40	No. of ransomware attacks (30-day average) per internet user	1/2
		41	No. of email leaks per internet user (quarterly average 2020 Q3- 2023 Q3)	1/2
	Trust	42	Per cent of respondents who are somewhat concerned about online privacy	1/2
		43	Per cent of respondents who say they trust the internet	1/2
SUSTAINABILITY	Green Digital Tech	44	Market revenue from green data centres as a % of revenues from total data centres	1/5
		45	Market revenue from Energy Management and Environment, Health, and Safety (EHS) software including carbon footprint management as a % of revenues from total software revenue	1/5
		46	Per cent of digital startups in total energy startups	1/5
		47	Market revenue from sustainable electronics as share of revenue from total electronics	1/5
		48	E-waste generation in kilo tonnes per internet user	1/5
	Green R&D	49	Patents filed in Smart Grids as a % of total patents filed (2000-2021)	1/2
		50	Patents filed in Information/Communication Technologies for Electro-mobility as a % of total patents filed (2000-2021)	1/2

Missing Values: *In case an indicator has a missing value for a particular country, the weights for the remaining indicators within that sub-pillar are adjusted such that they add up to 1. If less than two indicators were available for a sub-pillar, then the sub-pillar is dropped. Similarly, for the aggregation from sub-pillar to pillar, if there is missing data for sub-pillars, weights for the remaining sub-pillars are adjusted to ensure they add up to 1. If less than two sub-pillars were available, then the pillar is dropped.*

2 Gross Fixed Capital Formation

Annexure 2: Common indicators between CHIPS and other global indices.

CHIPS (User)	ICT Development Index (ITU)	Network Readiness Index (Portulans)[1]
Price of mobile data and voice basket (High Consumption) as a % of GNI per capita	Mobile data and voice high-consumption basket price (as % of GNI per capita)	Mobile Tariffs
Price of mobile data and voice basket (Low Consumption) as a % of GNI per capita	X	Mobile Tariffs
Price of cheapest smartphone in USD as a % of average monthly income	X	Handset prices
Price of fixed broadband internet in USD (PPP adjusted)	Fixed-broadband Internet basket price (as % of GNI per capita)	X
Median Mobile Download Speeds (Mbps)	X	X
Median Fixed Broadband Download Speeds (Mbps)	X	X
Per cent of population using the internet	Individuals using the Internet (%)	X
Mobile cellular subscriptions per 100 people	X	X
X	Active mobile-broadband subscriptions per 100 inhabitants	Active mobile broadband subscription count
X	Households with Internet access at home (%)	FTTH / building internet subscriptions
X	Population covered by at least a 3G mobile network (%)	Population covered at least by a 3G mobile network
Per cent of population covered by LTE	Population covered by at least a 4G/LTE mobile network (%)	X
X	Individuals who own a mobile phone (%)	X
Per cent of population using a smart phone	X	X
Gender gap in per cent of population using the internet[2]	X	Gender gap in internet use
Per cent of internet users (16-64 years) using social media for work related activities	X	Use of virtual social networks
Per cent of internet users using digital food delivery platforms	X	X
Per cent of internet users using digital health applications	X	X
Per cent of internet users doing ecommerce	X	Internet shopping
No. of mobile app downloads per internet user	X	X

1 Indicators on Quality of Life, SDG contribution and Regulation are not measured under CHIPS. Many indicators from other sub-pillars like Economy, Governments, Individuals, etc. which are enablers are also not a part of CHIPS. The complete list of NRI indicators is available here - https://networkreadinessindex.org/

2 Calculated as the difference between % of male population using the internet and % of female population using the internet, divided by % of total population using the internet.

Video On Demand Users as a % of internet users	X	X
Average monthly mobile broadband internet traffic per mobile broadband subscription (MB)	Mobile broadband Internet traffic per subscription (GB)	X
Average monthly fixed broadband internet traffic per fixed broadband subscription (MB)	Fixed broadband Internet traffic per subscription (GB)	X
Value of digital payment transactions (PPP exchange rate adjusted) per internet user	X	X
Per cent of internet users who made or received a digital payment	X	Online access to financial account
Per cent of people (age 15+) who received private sector wages into an account	X	Online access to financial account
Neo banking Transaction value (USD) (PPP adjusted)	X	X
Per cent of public sector wage recipients (age 15+) who received public sector wages into an account	X	X
Per cent of government transfer or pension recipients (age 15+) who received a transfer into an account	X	X
ICT service exports as a % of service exports (BoP)		ICT services export
ICT Value-added as a % of GDP	X	X
No. of AI publications as a % of all publications	X	AI scientific publication
Contributions to Github AI Projects (%)	X	Github Commits
VC Investments in AI as a % of Investments (GFCF)	X	Investments in emerging technology
No. of Startups per billion USD ICT value-added	X	X
Valuation of Unicorns per USD of Stock Market Valuation	X	X
Consumer IoT Revenues per internet user (PPP adjusted)	X	Adoption of emerging technologies
AR/VR Revenues per smartphone user (PPP adjusted)	X	Adoption of emerging technologies
Metaverse Revenues per smartphone user (PPP adjusted)	X	Adoption of emerging technologies
DeFi Revenue per internet user (PPP adjusted)	X	Adoption of emerging technologies
Cybersecurity spending per user (PPP adjusted)	X	Global Cyber Index[3]
Per cent of total patents that are cybersecurity related (cumulative 2018-2022)	X	X
No. of Secure servers per internet user	X	Secure internet servers
No. of ransomware attacks (30-day average) per internet user	X	X

3 Composite index measuring the level of cybersecurity commitments.

No. of email leaks per internet user (quarterly average 2020 Q3- 2023 Q3)	X	X
Per cent of respondents who are somewhat concerned about online privacy	X	X
Per cent of respondents who say they trust the internet	X	X
Market revenue from green data centres as a % of revenues from total data centres	X	X
Market revenue from Energy Management and Environment, Health, and Safety (EHS) software including carbon footprint management as a % of revenues from total software revenue	X	X
Per cent of digital startups in total energy startups	X	X
Market revenue from sustainable electronics as share of revenue from total electronics	X	X
E-waste generation in kilo tonnes per internet user	X	X
Patents filed in Smart Grids as a % of total patents filed (2000-2021)	X	X
Patents filed in Information/Communication Technologies for Electromobility as a % of total patents filed (2000-2021)	X	X

Note: X stands for not included

Annexure 3: CHIP Framework and Methodology (Sub-National)

The framework for CHIP (sub-national) closely follows that of the cross-country analysis with a few differences. The sub-national index does not include the Sustain pillar, due to lack of data. The index is therefore calculated across four pillars, with equal weights of for the pillars C, H, and I, and the pillar P, as in the case of CHIPS (cross-country), is given half the weight as the other pillars (). The aggregation from indicator to sub-pillar, and from sub-pillar to pillar follows the same steps as the cross-country indices, described in Annexure I. See Table below for list of indicators and their weights within the sub-pillar.

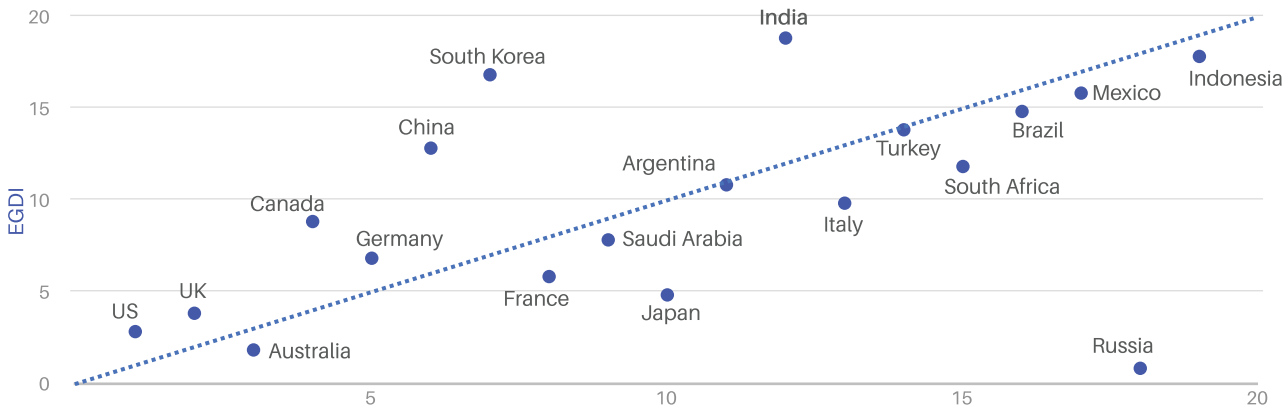
Pillar	Sub-pillar	Sl. no	Indicator Description	Weight within sub-pillar
CONNECT	Access (Individual)	1	% of population that are internet users	1/2
		2	% of population that are smartphone users	1/2
	Inclusion (Geography)	3	Urban-rural gap in per cent of households with atleast one wireless connection	1/4
		4	Urban-rural gap in per cent of population that are smartphone users	1/4
		5	Urban-rural gap in per cent of population that are feature phone users	1/4
		6	Urban-rural gap in per cent of population using the internet	1/4
	Inclusion (Gender)	7	Male-female gap in per cent of population using the internet	1/3

CONNECT	Inclusion (Gender)	8	Male-female gap in per cent of population that are smartphone users	1/3
		9	Male-female gap in per cent of population that are feature phone users	1/3
	Quality	10	Median Fixed download speed (mbps)	1/2
		11	Median mobile download speeds (mbps)	1/2
	Affordability	12	Price of cheapest smartphone as a share of median monthly income of the bottom 40th percentile	1/2
		13	Price of cheapest internet-enabled feature phone as a share of median monthly income of the bottom 40th percentile	1/2
	Access (Government)	14	Per cent of police Stations connected to the internet	1/5
		15	Per cent of public hospitals connected to broadband	1/5
		16	Per cent of schools with a functional computer facility	1/5
		17	Per cent of schools with an internet connection	1/5
		18	Per cent of Gram Panchayats that are service-ready (have internet connections through the BharatNet program)	1/5
HARNESS	Apps and Platforms	19	Per cent of population doing e-learning	1/6
		20	Per cent of population doing social networking	1/6
		21	Per cent of population doing e-commerce	1/6
		22	Per cent of population doing online work-related activities	1/6
		23	Per cent of population doing e-banking	1/6
		24	Per cent of population engaged in e-healthcare	1/6
	Public Services (general)	25	e-transactions per 1000 population recorded on e-Taal on State Government projects	1/6
		26	Per cent of population that are users of UMANG (e-governance application)	1/6
		27	No. of PMJAY e-cards created per capita (health insurance)	1/6
		28	Per cent of villages with spatial data verified under the Digital India Land Records Modernization program	1/6
		29	Per cent of Gram Panchayats covered with Common Service Centres	1/6
		30	Per cent of police stations in which reports are generated through CCTNS	1/6
	Public Services (DPI)	31	Per cent of population with Aadhaar	1/4
		32	Per cent of population with health IDs	1/4
		33	No. of facilities per thousand population registered on Health Facilities Registry (HFR) under Ayushman Bharat Digital Mission	1/4
		34	No. of registered PhonePe users per person	1/4
INNOVATE	Investments & Startups	35	No. of recognised start-ups	1/2
		36	Funds invested in start-ups (in Rs. crores)	1/2
	Business Innovation	37	Per cent of firms Identified as innovators	1/2
		38	Per cent of firms using advanced/emerging technologies	1/2
	Knowledge Production	39	Per cent of schools in which Atal Tinkering Labs (for robotics, IoT, 3D & other training) have been established	1/2
		40	No. of top-300 ranked innovative institutions	1/2

PROTECT	Cybercrime Reporting	41	IPC offences per lakh population - Cyber Blackmailing/ Threatening (Sec.506,503,384 IPC)	1/8
		42	IPC offences per lakh population - Fake News on Social Media (Sec.505)	1/8
		43	IPC offences per lakh population - Other Offences (r/w IT Act) per lakh	1/8
		44	IPC crimes (involving communication devices as medium or target) per lakh population - (r/w IT Act) - Fraud (Sec.420 r/w Sec.465,468- 471 IPC)	1/8
		45	Offences under I.T. Act per lakh population - Computer Related Offences - Identity Theft (Sec.66C)	1/8
		46	Offences under I.T. Act per lakh population - Computer Related Offences - Violation of Privacy (Sec.66E)	1/8
		47	Offences under I.T. Act per lakh population - Publication/ transmission of obscene / sexually explicit act in electronic form (Sec. 67)	1/8
		48	Cybercrimes against women per lakh women	1/8
	Cybercrime Resolution Mechanisms	49	Per cent of Cybercrime cases pending - Police	1/2
		50	Per cent of Cybercrime cases pending - Court	1/2

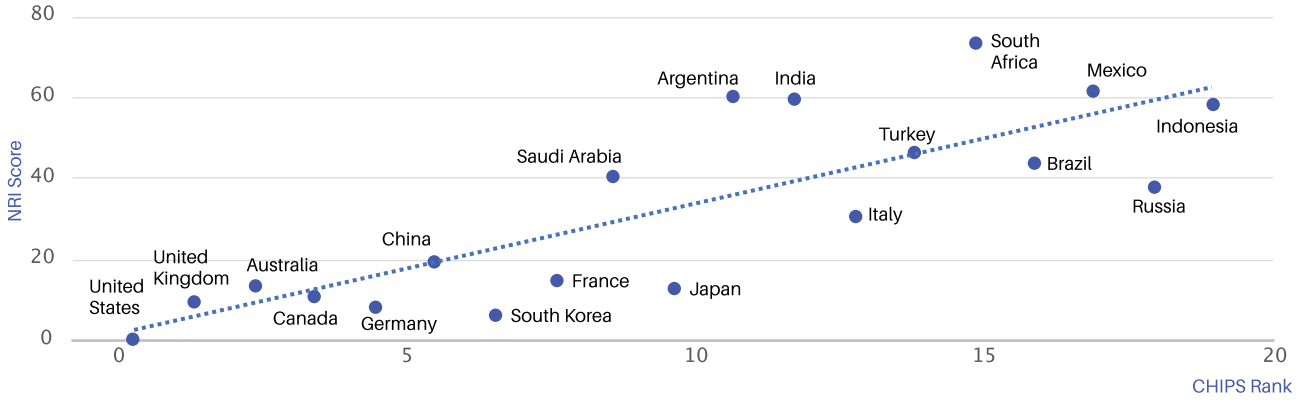
Annexure 4: Comparison of CHIPS (User) with other global indices

CHIPS (User) versus UN-EGDI



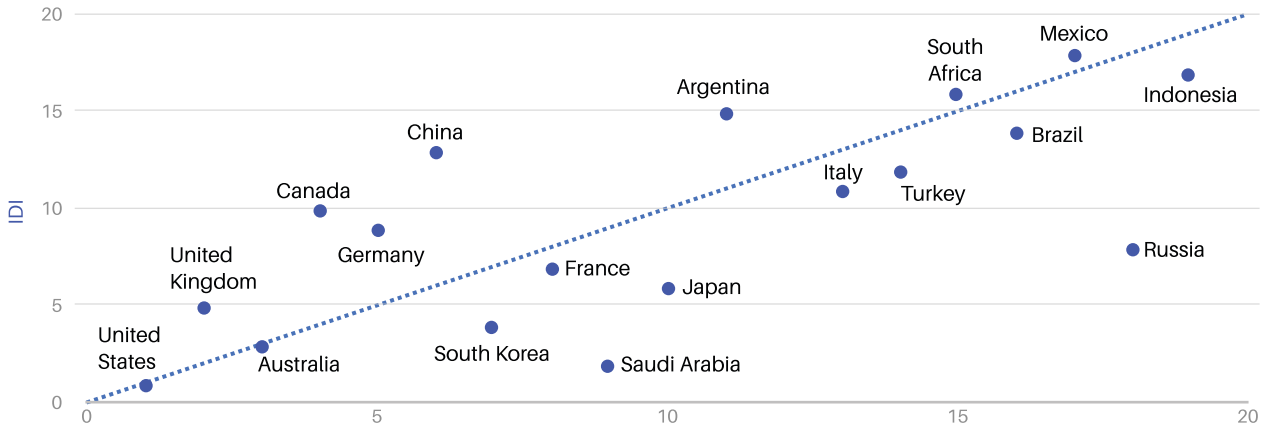
Source: IPCIDE Research and UN E-Gov Index | Note: EDGI Ranks have been adjusted within the G20

CHIPS (User) versus NRI



Source: IPCIDE Research and Network Readiness Index | Note: The NRI Rankings have been readjusted within the G20

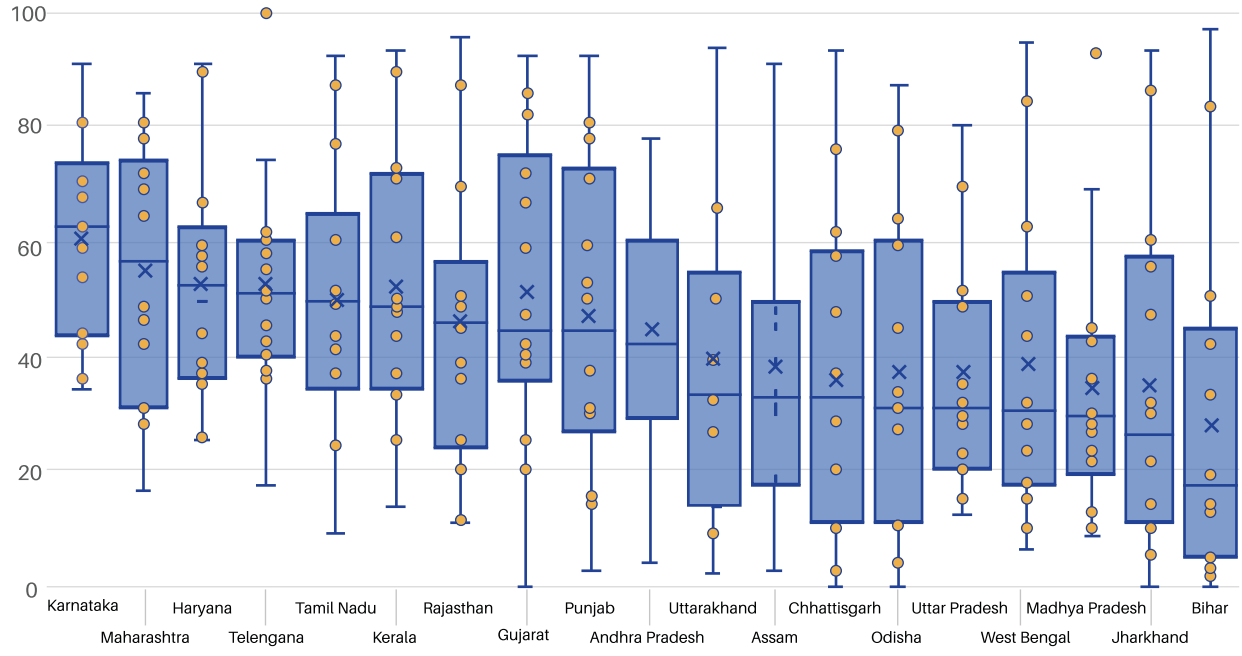
CHIPS (User) versus IDI



Note Source: IPCIDE Research and ITU Development Index | Note: The IDI Rankings have been readjusted within the G20

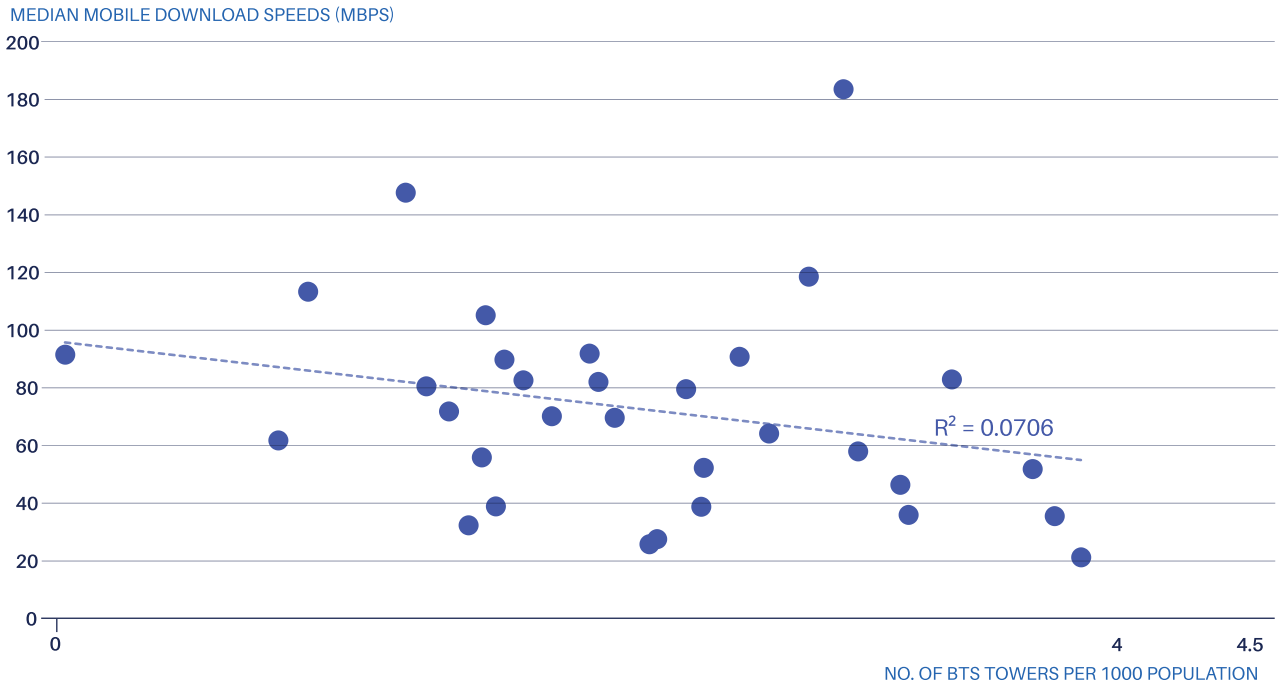
Annexure 5: Variation in performance of large states across different sub-pillars

SUB-PILLAR SCORES



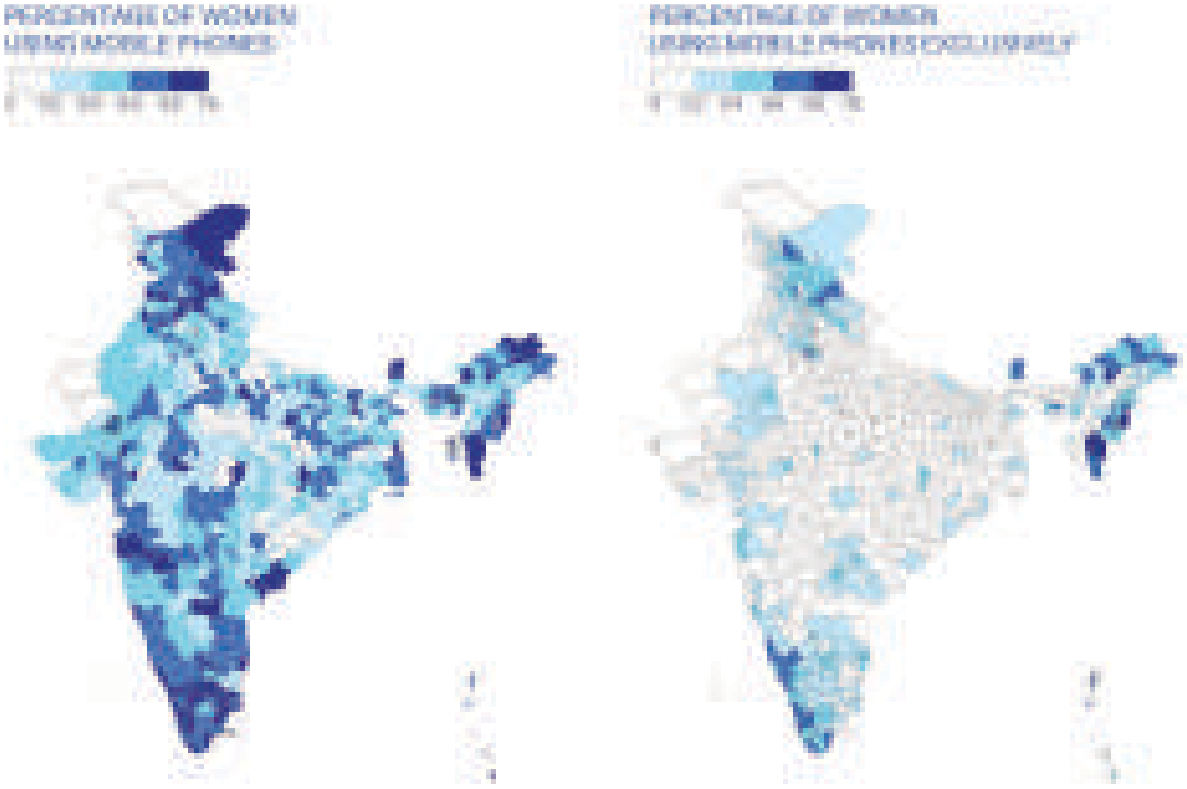
Source: IPCIDE Research

Annexure 6: Availability of infrastructure does not show any correlation with the quality of the internet in a given state or UT



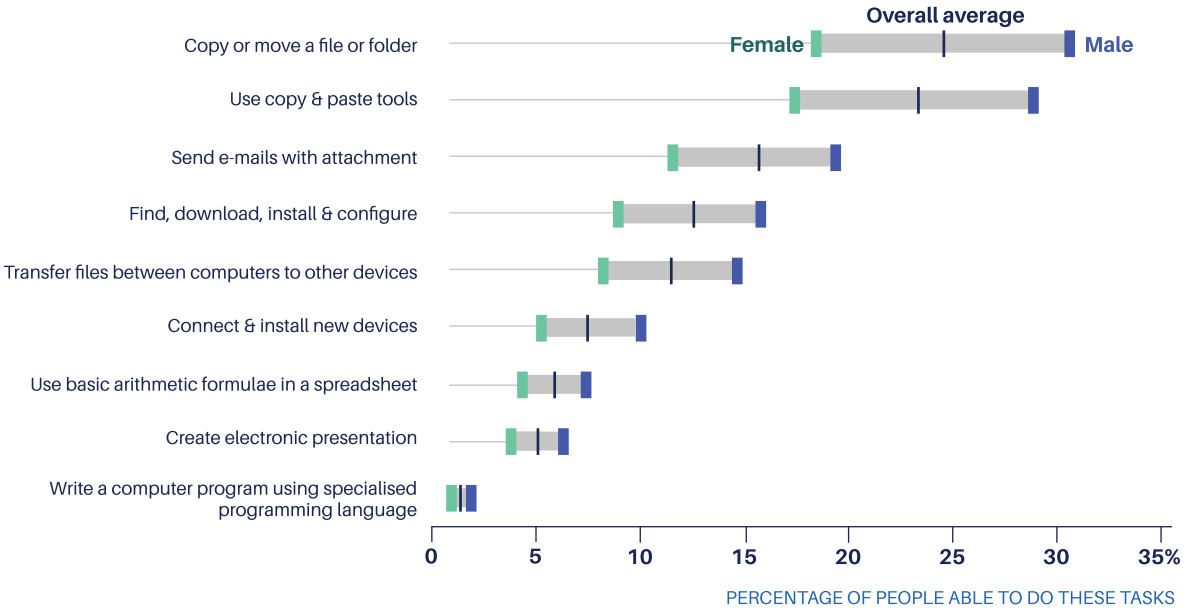
Source: IPCIDE Research and India Mobile Congress

Annexure 7: A large proportion of women's access is based on shared use of mobile phones



Source: NSS Multiple Indicator Survey (2020-21) | Note: Possession of any mobile phone with an active sim card in the last three months. Exclusive use iof mobile phone was solely used by the woman for personal reasons to make personal calls or access the internet.

Annexure 8: Gender divide in digital literacy and an overall lack of advanced digital skills



Source: NSS Multiple Indicator Survey (2020-21)

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