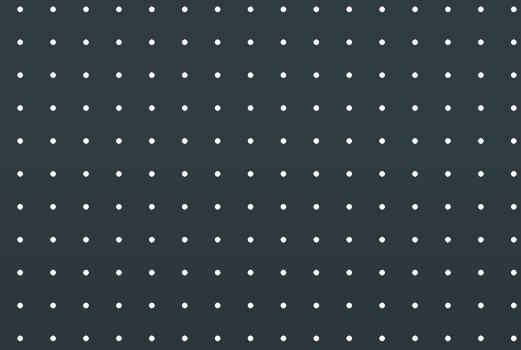June 2024

Responsible DPI for Improving Outcomes Beyond Inclusion

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ACKNOWLEDGEMENTS

Abstract

Digital public infrastructure (DPI) is increasingly recognized as a core component of modern governance and economic development, integral to advancing financial inclusion and supporting sustainable development goals. The concept gained traction with India's G20 presidency and initiatives such as India Stack and e-Estonia, which have demonstrated the transformative power of digital technologies in public service delivery and financial transactions. These precedents underline the potential of DPI to revolutionize access to public goods and services, enhancing efficiency, transparency, and citizen engagement.

Amid the enthusiasm to expand and scale DPI models to dozens of new markets, this report explores the opportunities for DPI to be built and deployed responsibly for three fundamental elements of financial inclusion: identity (ID), payments, and consent-based data exchanges. Reviewing examples and evidence to date, the paper examines DPI through three lenses — governance, innovation for value and financial sustainability, and citizen rights and measurable impact outcomes — across each element of ID, payments, and data exchange. It emphasizes the varied governance models and the distinct roles assumed by public and private sector entities within the DPI ecosystem, highlighting the complexity and necessity of balancing stakeholder interests, ensuring trust, and safeguarding citizen rights, privacy, and security in the digital age.

The analysis aims to shed light on the multifaceted nature of DPI and raise outstanding questions stakeholders must consider for responsible and effective DPI development and implementation. As the DPI space is rapidly evolving, there are many unresolved questions that require further scrutiny. In raising these questions, we acknowledge that we are still at an early stage in measuring impact, and have to first agree on what needs to be measured. This can help design systems that provide metrics beyond just availability and usage of digital financial services delivered through DPI rails. The objective of this paper is not to provide all the answers but rather to identify open questions that require further research and spotlight the need to build guardrails as an inclusive finance community in order to achieve the potential that DPI holds in delivering positive outcomes through digital financial services.

Contents

01 **Introduction**

Digital public infrastructure (DPI) has received significant attention recently from policymakers and development professionals around the world.[1] The term "DPI" and the topic of digital provision of public services began gaining prominence in inclusive finance a few years ago, particularly with the establishment of the "India Stack" and catalyzed by India's G20 presidency, where the topic received significant attention. India progressively rolled out a set of digital infrastructure components and open APIs that has enabled government, businesses, and individuals to conduct electronic transactions. Starting in 2009 with India's Aadhaar biometric identity program, followed by eKYC and esignature systems, along with a universal payments interface (UPI), India rapidly enabled a "presence-less, paperless, cashless service delivery"[2] of financial transactions, replacing what had been a largely cash-driven system. The rollout of India Stack was the major driver of exponential growth in access to financial services seen by more than doubling of account ownership over the course of a decade, from 35 percent to 78 percent of adults, with significant strides in the elimination of income and

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1 DPI is considered to be related to the broader area of Digital Public Goods (DPG) — the set of open-source software, models, and standards that countries can use to operationalize their DPI. (For details, see https://www.oecd-ilibrary.org/sites/c023cb2e-en/index.html?itemId=/content/component/c023cb2e-en). This paper references some aspects of DPG but largely focuses on DPI, as the authors consider DPI to be the backbone of delivering digital financial services.

2 India Stack. (n.d.). Homepage. https://indiastack.org

gender gaps in account ownership.[3] However, it should be noted that India also has the highest share of account holders with inactive accounts across developing economies, and at 35 percent is about seven times the average for all developing economies.[4]

Another prominent DPI example is Estonia, which made significant investments into digital technology in the 1990s after emerging from its Soviet legacy. What followed was the establishment of e-Estonia,[5] a vast set of tools and capabilities that enables citizens and residents to interact with the government using information and communication technology (ICT) solutions. Today, 99 percent of Estonia's public services are accessible online via their one-time login gateway X-Road.[6] This system reportedly saves Estonians an estimated 820 years of working time every year and approximately 2 percent of their GDP.[7]

More recent interest in DPI gained particular significance in the wake of the COVID-19 pandemic, which highlighted the critical need for national infrastructure to collate health information and, crucially, provide emergency disbursements to vulnerable people. According to the World Bank, global cash transfer programs nearly doubled compared to pre-COVID levels, although there are significant regional differences.[8] What often made the difference in the success of national pandemic response programs was the existence of digital infrastructure pre-COVID. At the same time, the restrictions imposed by the pandemic rapidly sped up the transition of social, civic, and economic lives into digital spaces.

Today, it is no surprise that DPI has become a prominent topic of

This paper was written as part of ongoing work under the aegis of the Responsible Finance Forum (RFF) and aims to inform the inclusive finance sector on responsible practices and consumer protection considerations in a rapidly evolving world of digital financial services.

RFF is a global convening platform that brings stakeholders together to assess and manage evolving consumer risks faced by financial systems and low-income people. Through convenings and working groups, RFF provides a forward-thinking neutral space for knowledge sharing, ongoing research, and global dialogue to improve risk identification and mitigation.

The Center for Financial Inclusion (CFI) has served as the convenor of RFF since 2022.

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3   Klapper, L., Singer, D., & Ansar, S. (2022). The Global Findex 2021: India [Brief]. World Bank. https://thedocs.worldbank.org/en/doc/4c4fe6db0fd7a7521a70a59ac518d74b-0050062022/original/Findex2021-India-Country-Brief.pdf

4   Klapper et al. (2022)

5   E-Estonia. (n.d.-a). Homepage. https://e-estonia.com

6   OECD. (2019). Digital Opportunities for Better Agricultural Policies. https://www.oecd-ilibrary.org/sites/510a82b5-en/index.html?itemId=/content/component/510a82b5-en

7   Mittal, K., Pande, V., & Viswanathan, A. (2022). Creating 'Good' Digital Public Infrastructure. Observer Research Foundation. https://www.orfonline.org/expert-speak/creating-good-digital-public-infrastructure

8   Gentilini, U. (2021, January 11). A Game Changer for Social Protection? Six reflections on COVID-19 and the future of cash transfers. World Bank. https://blogs.worldbank.org/developmenttalk/game-changer-social-protection-six-reflections-covid-19-and-future-cash-transfers

Digital public infrastructure is poised to scale to dozens of countries globally over the coming decade.

conversation. In 2023, India's G20 presidency focused on DPI as an accelerator of the United Nations Sustainable Development Goals (SDGs), resulting in three major DPI-related deliverables: a framework document for building DPI, the establishment of a social impact fund for DPI development in low- and middle-income countries (LMICs), and the creation of the Global DPI Repository (GDPIR) for the exchange of information and best practices.[9] In September 2023, the 77th session of the United Nations General Assembly[10] "emphasized the need for 'country-led digital cooperation to build safe, trusted, and inclusive DPI' under its theme of 'transformative solutions to interlocking challenges.'" [11]

Meanwhile, various organizations — from think tanks to multilateral development organizations — are rapidly developing a body of literature on the topic.[12] The GPFI defines DPI as "interoperable, open and inclusive systems supported by technology to provide essential, society-wide public and private services."[13] Although the definition of what constitutes DPI varies widely by country context, digital ID, payments, and data exchange are largely considered as foundational components. While clarity on what can be included in DPI still needs to be achieved, there are some indicators of what qualifies as DPI versus traditional financial infrastructure: DPI is meant to: "a) have a cross-sectoral nature; b) show use across a wide range of economic and social interactions; and c) have an emphasis on serving public policy objectives."[14] Yet, with this potential, there is also a set of risks that must be considered — some of which are acknowledged,[15] such as operational risks such as privacy and security, legal and regulatory risks, exclusion risks, and consumer protection risks, and others that are likely to emerge as DPI is rolled out in various country contexts.

9   Government of India Press Information Bureau. (2023, November 25). Prime Minister announces completion of Global Digital Public Infrastructure Repository and creation of a Social Impact Fund to advance Digital Public Infrastructure in Global South [Press release]. https://pib.gov.in/PressReleseDetailm.aspx?PRID=1979115

10 United Nations Development Programme. (n.d.-a). UNGA 77th: The Future Digital Cooperation. https://www.undp.org/digital/unga77

11 Porteous, D., Vora, P., Chaturvedi, R., & Rabley, P. (2023, October 2). Understanding Digital Public Infrastructure: What it Means — and Why it Matters — to Businesses and Governments in Emerging Markets. Next Billion. https://nextbillion.net/digital-public-infrastructure-why-it-matters-business-governments-emerging-markets/

12 This is intended to be a working paper since thinking on DPI is rapidly evolving and will have to be updated periodically for relevance.

13 Global Partnership for Financial Inclusion. (2023). G20 Policy Recommendations for Advancing Financial Inclusion and Productivity Gains through Digital Public Infrastructure. https://www.gpfi.org/sites/gpfi/files/G20%20Policy%20Recommendations%20for%20Advancing%20Financial%20Inclusion%20and%20Productivity%20Gains%20through%20Digital%20Public%20Infrastructure.pdf

14 Global Partnership for Financial Inclusion (2023)

15 Global Partnership for Financial Inclusion (2023)

02   **Landscape**

Digital public infrastructure is poised to scale to dozens of countries globally over the coming decade — an expansion which will have implications for tens of millions of consumers and their financial lives. Amid this growth, critical questions remain that must be resolved to ensure that the design and deployment of DPI is responsible and advances the objectives of financial inclusion and health, i.e., economic equity, greater choice and agency, and trust in formal financial services. This report is the first in a series of knowledge resources to elicit questions and identify topics for further research and collective action to address issues. This work aims to convene the inclusive finance community to jointly create a roadmap for the future of responsible DPI.

This report first provides a landscape of the current discourse around the definition of DPI, as well as several examples of DPI implementations to date. It then delves into the three foundational elements of DPI for financial inclusion — identity (ID), payments, and consent-based data exchanges — and identifies examples of what has, and has not, worked in practice. The paper closes by identifying outstanding questions, with a view to highlighting key areas for further work, particularly around governance, innovation for user benefits and sustainability, and citizen rights, to be addressed by the Center for Financial Inclusion (CFI) and other actors under the Responsible Finance Forum (RFF).

2.1 DPI: What Does It Mean?

To date, there is still no common definition of DPI. However, there have been attempts to arrive at consensus. DPI is largely recognized as "a combination of networked open technology standards built for public interest, enabling governance, and a community of innovative and competitive market players working to drive innovation across public programs."[16] In 2023, the G20 countries drew from descriptions provided by development actors including the World Bank, UNDP, the Gates Foundation, IMF, Co-Develop, DIAL, and GovStack, among others, and arrived at the following draft definition: "A set of shared digital systems which is interoperable, inclusive, secure and trusted, built on open standards and specifications governed by enabling rules that respect fundamental rights to deliver and provide access to public and/or private services at societal scale to drive innovation, trust and competition."[17]

Various studies and reports have emphasized a series of principles that should guide the design and development of DPI initiatives. For example, the Harvard Business Review says the attributes of "good DPI" should include enabling the UN's Sustainable Development Goals (SDGs) and be "inclusive, citizen-centric, trustworthy, interoperable, supportive of innovation,

resilient, and politically viable."[18] Others like the Initiative for Digital Public Infrastructure at UMass Amherst describe digital public infrastructure as "infrastructures that let us engage in public and civic life in digital spaces," and include online platforms like Facebook, Twitter, and YouTube in the definition.[19] There have also been debates on using the term "public" when ownership may be public or private; this paper draws on the World Bank's use of the term "public" to refer to public benefit and access, and not necessarily ownership.[20] Researchers at UCL have used the "attribute versus functions" frame applied to DPI (see Table 1).

16   United Nations Development Programme. (n.d.-b). Digital Public Infrastructure. https://www.undp.org/digital/digital-public-infrastructure

17   Porteous, D. (2023). Is DPI a Useful Category or a Distraction? [White paper]. Integral. https://irp.cdn-website.com/779b0d6a/files/uploaded/Is%20DPI%20a%20useful%20category%20or%20a%20distraction%20V4.pdf

18   Chakravorti, B. (2023, May 22). The Case for Investing in Digital Public Infrastructure. Harvard Business Review. https://hbr.org/2023/05/the-case-for-investing-in-digital-public-infrastructure

19   Zuckerman, E. (2020, November 17). What is Digital Public Infrastructure? Center for Journalism & Liberty. https://www.journalismliberty.org/publications/what-is-digital-public-infrastructure

20   World Bank. (2023). 2022 Annual Review. https://documents1.worldbank.org/curated/en/099457402012317995/pdf/IDU00fd54093061a70475b0a5b50dd7e6cdfe147.pdf

TABLE 1: DIFFERENT WAYS OF FRAMING "PUBLICNESS" IN DPI[21]

	Framing for Publicness	Implicit Normative Values	Mechanisms for Value Creation
ATTRIBUTES	Interoperable through open standards	Dynamic efficiency and scale	Open and interoperable standards prevent lock-in and thus improve and increase and shape competition.
	Built using reusable building blocks	Dynamic efficiency and scale	The more digital infrastructure can be reusable, the higher the network effects and combinatorial innovation.
	Built using open-source licenses (or are unlicensed and in the public domain)	Efficiency and scale	Digital infrastructure with open-source licenses or in the public domain generate positive externalities through adoptability, adaptability, and prevention of lock-in.
FUNCTIONS	Foster community and social relationships	Social value	DPI resources in the context of social infrastructure can foster inter- and intra-communal relationships.
	Foster economic activity	Economic value	DPI can improve financial inclusion and mobilize the potentialities of economic agents.
	Guarantee essential capabilities	Capabilities and human rights	DPI can create the capabilities for individuals, businesses, and agents of society to participate and thrive in all dimensions of their lives.
	Guarantee better quality of life	Essential needs and human rights	DPI can guarantee the essential needs for human life, enhancing the overall well-being and happiness of the population, including considerations such as healthcare, education, and cultural enrichment.

Source: From Eaves et al. (2024)

In practice, a "one-size-fits-all" approach will likely never apply to DPI. Rather than trying to agree on a common definition, much of the current thinking focuses on finding a common approach based on key principles, defined by the G20 (see Table 2), or others such as openness, inclusivity, affordability, and empowerment.[22] There are also guidelines for thinking about DPI structural approaches. For example, the Centre for Digital Public Infrastructure (CDPI) [23] outlines five technology principles that illustrate how DPI efforts can be architected to be distinct from traditional digitization efforts: 1) interoperability; 2) minimalist, reusable building blocks; 3) diverse, inclusive innovation by the ecosystem; 4) a preference for remaining federated and decentralized; and 5) security and Privacy by Design.[24] There is also acknowledgement that DPI should not be too narrow in how it is seen (e.g., government-centered use cases only), but must include private sector capabilities (e.g., payments) and be allowed to expand into further next-generation applications (e.g., a BIS unified public ledger).[25]

21 Eaves, D., Mazzucato, M., & Vasconcellos, B. (2024). Digital public infrastructure and public value: What is 'public' about DPI? University College London, Institute for Innovation and Public Purpose Working Paper 2024-05. https://www.ucl.ac.uk/bartlett/public-purpose/publications/2024/mar/digital-public-infrastructure-and-public-value-what-public-about-dpi

22 Mohanty, A., & Sahu, S. (2025, May 17). What is DPI? The Need for a Principle-Based Approach. Carnegie India. https://carnegieindia.org/2025/05/17/what-is-dpi-need-for-principle-based-approach-pub-89764

23 Centre for Digital Public Infrastructure. (n.d.-a). Homepage. https://cdpi.dev

24 Centre for Digital Public Infrastructure. (n.d.-b). DPI Tech Architecture Principles. https://docs.cdpi.dev/the-dpi-wikipedia/dpi-tech-architecture-principles

25 BIS. (2025). Annual Economic Report. https://www.bis.org/publ/arpdf/ar2025e3.htm

TABLE 2: SUGGESTED PRINCIPLES FOR DPI UNDER INDIA'S G20 PRESIDENCY[26]

A. TECHNOLOGY	B. GOVERNANCE	C. ECOSYSTEM
1 INTEROPERABILITY Enable interoperability by using open-source solutions with a technology-neutral approach.	**1 PUBLIC BENEFIT, TRUST, AND TRANSPARENCY** Maximize public benefit, trust, and transparency through laws, regulations, policies, and capabilities to ensure DPI is safe, secure, trusted, and transparently governed; promotes competition and inclusion; and adheres to data protection and privacy principles.	**1 INCLUSIVITY** Eliminate or reduce economic, technical, or social barriers to enable last-mile access and avoid erroneous algorithmic bias.
2 MODULARITY AND EXTENSIBILITY Use a building block approach to accommodate changes to existing architecture without disruption.	**2 GRIEVANCE REDRESSAL** Define accessible and transparent mechanisms for grievance redressal, i.e., user touch points, processes, and responsible entities with a strong focus on actions for resolution.	**2 HUMAN RIGHTS** Adopt an approach that respects human rights at planning, designing, building, and operating stages.
3 SCALABILITY Use flexible design to easily accommodate growing demand without changing existing systems.	**3 INTELLECTUAL PROPERTY PROTECTION** Protect and provide adequate and effective enforcement of intellectual property rights for the rights-holders of technologies and other materials used in DPI based on existing legal frameworks.	**3 COLLABORATION** Encourage the participation of community actors at different stages of planning, designing, building, and operating to facilitate the development of user-centric solutions.
4 SECURITY AND PRIVACY BY DESIGN Embed key security features within the core design to ensure individual privacy, data protection, and technology resilience.		**4 SUSTAINABILITY** Ensure sustainability of DPI through multi-stakeholder participation that ensures adequate financing for uninterrupted operations and a seamless user-focused service delivery.

Source: UNDP (2025)

Ultimately, the definition of DPI is an "evolving concept,"[27][28] encompassing systems that cut across both public and private ownership and activities, all of which benefit the broader society. This is certainly the case in digital payment systems, which are often owned and operated by utilities established by private sector players, that utilize government systems such as ID and are subject to regulatory oversight by the state.[29] However, the principles offer a way to think about other layers of DPI so it can continue

26 United Nations Development Programme. (2025). The DPI Approach: A Playbook. https://www.undp.org/publications/dpi-approach-playbook

27 United Nations Development Programme. (n.d.-b). Digital Public Infrastructure. https://www.undp.org/digital/digital-public-infrastructure

28 Eaves, D., & Sandman, J. (n.d.). Explaining Co-Develop's Understanding of Digital Public Infrastructure. Co-Develop. https://www.codevelop.fund/insights-1/explaining-co-develops-understanding-of-digital-public-infrastructure

29 Porteous et al. (2025)

to evolve to meet the future needs of a digital society.

A key aspect of broad societal benefit is in making sure that everyone is not just willing but able to use the services offered via DPI. Marginalized groups are too often overlooked when it comes to designing how services will work. As such, there is a growing acknowledgement of the concept of universal design in ensuring usability, accessibility, and inclusivity of service development to the greatest extent possible, without the need for adaptation or specialized design.[30] As DPI evolves, the focus of the next stage would be to shift beyond inclusive finance to broader societal impact and measure outcomes on users who access services built on DPI.

Beyond the definition, it is important to develop a common understanding and shared language for the purpose of this analysis. Rather than arriving at a single definition, this paper follows David Porteous' evolving "definitional space" for DPI, which identifies broad and narrow definitions for each of the following terms: "digital," "public," and "infrastructure" (see Table 2).[31] In the early stages of DPI development, broad definitions are appropriate to advance the understanding of DPI. This paper argues that maintaining this definitional vagueness is still valuable as the DPI space continues to evolve.

TABLE 2: DEFINITIONAL SPACE OF DPI

DEFINITIONAL POSSIBILITIES	DIGITAL	PUBLIC	INFRASTRUCTURE
	1 Core: IT only	1 Ownership: May have public ownership or public-private ownership and/or open-source licensing of technology, but with public oversight	1 Narrow (tech usage): Hardware and software used as a foundation
	2 Narrow: Reliant on digital	2 Scale: Reaching or likely to reach societal scale	2 Common/broad: Supporting a service considered essential or important to human life
	3 Broad: Significantly enhanced by digital	3 Purpose: Having a purpose aligned with societal goals	3 Sectoral scope: Have applicability beyond a single sector
	Boundary Indicators: Multilateral access test and operational responsibility test		

Source: Adapted from Porteous (2025)

30 Burgstahler, S. (2020). Universal Design: Process, Principles, and Application. DO-IT, University of Washington. https://www.washington.edu/doit/universal-design-process-principles-and-applications

31 Porteous (2025)

The digital public infrastructure "definitional space" serves as a versatile guide to place various initiatives within the spectrum of DPI — from narrowly defined to more broad and even beyond traditional interpretations. This approach emphasizes the diverse manifestations of DPI, shaped by the specific nature of the infrastructure and the unique dynamics of the market environment in which it operates. It also allows for innovation by building in the ability to be flexible and course correct as needed based on local contexts.

One of the core tests that Porteous proposes as "boundary indicators" for infrastructure focuses on key governance aspects related to the nature of access to the infrastructure and the presence (or lack thereof) of entities in charge of their operations. Two key questions are part of the test:[32]

A. **Multilateral Access Test —** *Is access to the infrastructure multilateral* (i.e., can it be used equally by multiple participants)? If not, it is likely to be considered as a service or application, not as infrastructure.

B. **Operational Responsibility Test —** *Is there an operator responsible for making the solution function, either in part or in full?* If not, it may simply be a technology or a set of code or data.

These two tests help to understand whether something is to be considered "infrastructure." For example, by applying the multilateral access test and operational responsibility test, it is clear

The three foundational elements of DPI for inclusive finance are identity (ID), payments, and consent-based data exchange.

that M-Pesa in Kenya is not considered "infrastructure" because it does not allow multilateral access. By contrast, PesaLink — a much less widespread instant payment solution in Kenya supported by the banking association — is considered infrastructure. By the same token, payment solutions provided by banking associations, such as PayNow in Singapore or PromptPay in Thailand, fall under a broader definition of DPI since they are regulated by the Monetary Authority of Singapore (MAS) and Bank of Thailand (BoT), respectively, and pass both tests. Pix in Brazil as well as UPI in India, which allow for third-party payment initiation, also fall squarely in the definitional space discussed above.

Another important discussion lies around whether open banking falls inside or outside the scope of DPI.

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32   Porteous (2025)
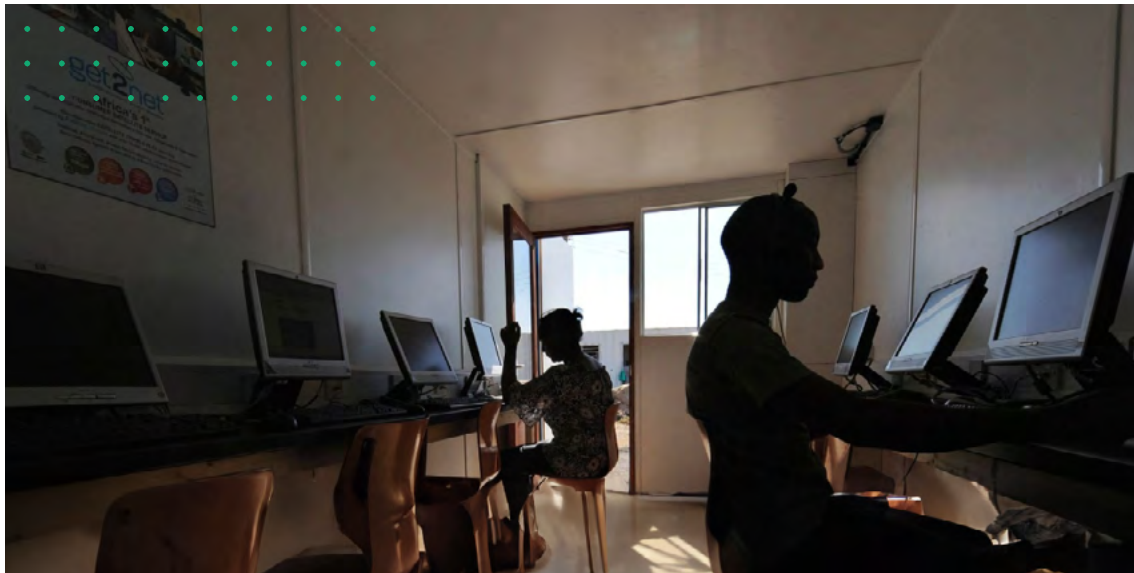
Porteous suggests that open banking generally falls outside the scope of DPI, except for countries such as the U.K., where the operational responsibility of setting standards and keeping a directory of participants is managed by the Open Banking Implementation Entity (OBIE).[33]

CFI's forthcoming analysis of data sharing arrangements in the financial sector suggests that despite the diversity of approaches in open banking, governance mechanisms are evolving to become clearer and more nuanced, increasingly fitting within the scope of DPI. For example, the role of Sahamati in India — which appears to be on the path to become a self-regulatory organization — can arguably be considered DPI, as it sets technical and commercial standards and maintains a list of ecosystem participants, among other roles.

Another example is Brazil. Although Brazil does not have the equivalent of OBIE or Sahamati, they have established a governance mechanism composed of a Deliberative Council, which is the highest decision-making body within Brazil's open finance structure. Below the Council, technical groups discuss specific matters related to open finance and propose standards and regulations, which are then approved by the Deliberative Council. In some markets, however, open banking may not fit the definition of DPI. For example, in the U.S., open banking is primarily driven by the market and linked to a bilateral data exchange agreement facilitated by commercial account aggregators.

2.2 Foundational Layers of DPI for Financial Inclusion

The three foundational elements of DPI for inclusive finance are identity (ID), payments, and consent-based data exchange.[34] As outlined previously, broader definitions of DPI include esignatures and APIs; this paper focuses on the three foundational layers and

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33 OBIE is a not-for-profit organization created by British banks.
34 Porteous (2025)

includes discussions on APIs as part of the data exchange layer.[35]

All three are crucial for the safe and secure exchange of digital data — ID is necessary to authenticate ownership, payment systems can be linked to a recognized digital value, and personal information can be used to create value through customized financial services in the case of consent-based data exchange. Therefore, these three are "applied examples of trust frameworks." [36] For consumers to trust digital financial services that use DPI, the inclusive finance space must address several outstanding questions, especially in light of initiatives that seek to scale current models to multiple countries in the next few years.[37]

This section presents the three foundational elements and discusses how to implement them responsibly, particularly for vulnerable consumers. In analyzing the three elements of DPI, this paper also raises specific questions related to governance design, flags concerns pertaining to protecting users, and presents opportunities for innovations to benefit end users.

TABLE 3: FOUNDATIONAL ELEMENTS OF DPI FOR FINANCIAL INCLUSION

ELEMENT	DESCRIPTION	EXAMPLES
IDENTITY	Digital ID systems offer citizens a unique identity, simplifying access to a wide range of services. These systems vary from biometric-based to digital token-based, enhancing security and accessibility.	Aadhaar in India, Singpass in Singapore, e-ID in Estonia
PAYMENTS	Payment systems generally fall under the definition of DPI when they are interoperable, affordable and multilateral — i.e., provided by multiple institutions and through open interfaces.[38] Fast payment systems have evolved as specific examples of payment DPI and have been successful in instances with specific design features like user focus. Digital payments enable citizens to make payments for services, pay fees, submit taxes, and conduct other financial transactions. They support multiple payment methods, such as digital transfers or government-to-person payments, ensuring accessibility and convenience.	UPI in India, PayNow in Singapore, PromptPay in Thailand, Pix in Brazil
CONSENT-DRIVEN DATA EXCHANGE	Consent-driven data exchange frameworks allow secure sharing of personal or financial data with user consent. These systems vary in scope from financial services to broader data sharing, emphasizing user control and privacy.	Account aggregator framework in India, open finance in Brazil and the U.K., SGFinDex in Singapore

35   Centre for Digital Public Infrastructure. (n.d.-c). DPI Overview. https://docs.cdpi.dev/the-dpi-wikipedia/dpi-overview
36   Porteous (2025)
37   United Nations Development Programme. (2023, November 9). 11 'First-Mover' Countries Launch 50-in-5 Campaign to Accelerate Digital Public Infrastructure Adoption around the World. https://www.undp.org/news/11-first-mover-countries-launch-50-5-campaign-accelerate-digital-public-infrastructure-adoption-around-world
38   For more discussions, see the G20 Policy Recommendations for Advancing Financial Inclusion and Productivity Gains Through Digital Public Infrastructure, at https://www.gpfi.org/sites/gpfi/files/G20%20Policy%20Recommendations%20for%20Advancing%20Financial%20Inclusion%20and%20Productivity%20Gains%20through%20Digital%20Public%20Infrastructure.pdf

Together, the three elements are often referred to as a "stack" due to the interoperable nature and ability to build on the various layers.[39]

2.2.1 Digital Identity

Digital identity systems are the foundational layer to unlocking access to digital financial services. With a digital ID, people can efficiently and quickly access a variety of services and transaction types, which could ultimately lead to improved governance and socioeconomic inclusion. The most well-known example of digital identity is Aadhaar in India, which was established in 2009 as a voluntary identity system for all residents of India. Based on users' demographic and biometric data (10 fingerprints, two iris prints, and face photo), people use Aadhaar for a variety of purposes, including opening bank accounts, obtaining a mobile phone, accepting government welfare payments, attending school, etc. According to the Ministry of Electronics & IT, Aadhaar performs, on average, 2 billion authentications per month.[41]

However, the term "digital identity" is considerably complex and contains various layers of digitization, which in turn determines its potential to drive inclusion among marginalized populations. According to the World Bank, there are three core features of digital identity systems that must be considered:[42]

1. **Digital Data:** Refers to electronically stored identity records supporting easier access and verification as compared to paper-based systems. Despite widespread adoption, much of the global population lacks digital identity records, which impacts many people's ability to verify their own identity. While 186 (out of 198) countries do have foundational digital ID systems with identity records stored in digital format, approximately 375 million people (residing in the 12 countries that still have predominantly paper-based identity files) remain excluded.

2. **Digital Verification (In-Person):** Involves verifying an individual's identity using digital systems during face-to-face interactions. While widespread, variations in functionality and privacy measures exist, and in some cases, digital means cannot fully confirm an individual's ownership of their claimed identity. More than two-thirds of countries enable digital verification for in-person services, but functionality and privacy vary widely.

39   Porteous (2023)

40   For more discussions, see the G20 Policy Recommendations for Advancing Financial Inclusion and Productivity Gains Through Digital Public Infrastructure, at https://www.gpfi.org/sites/gpfi/files/G20%20Policy%20Recommendations%20for%20Advancing%20Financial%20Inclusion%20and%20Productivity%20Gains%20through%20Digital%20Public%20Infrastructure.pdf

41   Government of India Ministry of Electronics & IT. (2023). UIDAI's relentless initiatives lead to strengthening of Aadhaar eco-system [Press Release]. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1909255

42   Metz, A., Casher, C., & Clark, J. (2021). ID4D Global Dataset 2021 Volume 2: Digital Identification Progress & Gaps. World Bank. https://documents1.worldbank.org/curated/en/099020824141510923/pdf/P176541192f2c50e11bc5619be95c4fb2ed.pdf

3. Online Digital Authentication:
Allows individuals to remotely authenticate their identity for online services. Although digital IDs are available in numerous countries, a large global population remains without access to digital verification, which limits their participation in digital services. Although 81 countries have systems that enable remote service access, more than 3.3 billion people live without such capabilities, which affects deployment and security of government services online.

a.   Governance Approaches for Enabling Digital ID

A well-designed ID system can create social and economic growth by empowering both the end users and relying parties, resulting in an evolution of the digital economy.[43] The role of governance in digital ID systems is to build trust and promote inclusion, deepen access to a variety of services, and drive socioeconomic growth. Governance approaches, therefore, aim to balance the benefits of digital identification with the need to protect user privacy, ensure security, and manage the ethical use of personal data, and can

45   Monetary Authority of Singapore. (2019). Foundational Digital Infrastructures for Inclusive Digital Economies. https://www.mas.gov.sg/-/media/MAS/Fintech/FDI/Foundational%20Digital%20Infrastructures%20for%20Inclusive%20Digital%20Economies.pdf

adopt a range of approaches — from completely private sector-driven to government-driven solutions (see Figure 1).

FIGURE 1: OPTIMAL GOVERNANCE APPROACH DEPENDS ON COUNTRY CONTEXT

● **Private party**   ● **Public party**

1 LACK OF OVERARCHING GOVERNANCE	**2** PRIVATE COLLABORATIVE GOVERNANCE	**3** PRIVATE COLLABORATIVE GOVERNANCE GOVERNMENT INCENTIVISED	**4** PUBLIC–PRIVATE GOVERNANCE	**5** GOVERNMENT MANDATED
→ Every private party govrns own infrastructure → No common agreements and little interopability	→ Market-driven collaboration where private parties together govern → Little involvement of the government	→ Market-driven collaboration where private parties together govern → Little involvement of the government	→ Collaborative development of a public-private governance → Interoperability between public & private services is often a central theme	→ Public body is mandated to set up the governance → Often, governance is enforced and based on a regulatory framework
evrotrust Google Facebook	iDIN yes®	BankID SwissID bank ID	France Connect EHerkenning	AADHAAR singpass e-estonia

Examples are non–exhaustive

Source: Monetary Authority of Singapore (2019)

Foundational digital IDs in most countries are run and managed by government agencies. In India, the Unique Identification Authority of India (UIDAI) is responsible for overseeing Aadhaar's development, implementation, and maintenance of the system. The Aadhaar Act (2016) governs the use of Aadhaar for various purposes, including financial inclusion, access to government services, and taxation. Similarly, Singapore's digital ID system (Singpass) is managed by the Government Technology Agency of Singapore (GovTech) and offers residents access to over 1,400 services, ranging from banking to healthcare. With more than 4 million users by 2020, Singpass has become an essential tool, allowing users to retrieve personal information, digitally sign documents, and authorize transactions remotely through its app.

Other markets have adopted a collaborative approach between different government and private sector entities. Estonia's digital ID system is an example of a collaborative framework involving multiple stakeholders, including private sector actors. The

Estonian Information System Authority oversees digital ID authentication solutions, while the Police and Border Guard Board issues various identity credentials and the Ministry of Foreign Affairs manages the e-residency program. Private companies like Tieto Estonia AS and SK ID Solutions AS contribute technical solutions, including user support for ID card software and the issuance and validation of eID certificates, showcasing a public-private partnership model.[44] Some forms of identification, such as Sweden's BankID (which is owned and governed by the Swedish banks) and Norway's NemID (governed by the Norwegian government and developed in collaboration with banks), operate under a federated model driven by private entities in partnership with government bodies.[45]

Some countries use digital public goods (DPG) such as MOSIP (Modular Open-Source Identification Platform) — an open source, modular technology platform — to develop their own digital identity systems. Developed under the aegis of a nonprofit organization and based on India's Aadhaar system, MOSIP is now either in use or in trial in 11 countries, including Togo, Morocco, Sri Lanka, Guinea, Philippines, and Madagascar.[46] Ethiopia is emerging as an exemplar case in the use of MOSIP, having onboarded nearly 4 million citizens,[47] and has partnered with UNHCR to provide humanitarian services to about 0.9 million refugees, enabled by the digital ID.[48]

b.   Innovating for Value and Long-Term Sustainability

While developing design choices, innovating for user value should be one of the core objectives. The design choices of digital ID systems can influence costs differently, as shown by research conducted by the World Bank.[49] The return on investment (ROI) for digital ID systems, however, presents a compelling case for their adoption, offering substantial benefits that can outweigh implementation and maintenance costs. McKinsey's research[50] delineates the broad spectrum of advantages, including economic growth, increased inclusivity, enhanced efficiency, and reduced fraud, all contributing to a positive ROI. Digital IDs not only foster access to vital services, thereby driving economic expansion and inclusivity, but also streamline government operations and mitigate fraud risks.

In a separate analysis, Gelb and Diofasi conducted a survey on biometric voter

44   Financial Action Task Force. (2020). Guidance on Digital Identity. https://www.fatf-gafi.org/content/dam/fatf-gafi/guidance/Guidance-on-Digital-Identity.pdf
45   Identification for Development. (n.d.-a). Types of ID Systems. World Bank. https://id4d.worldbank.org/guide/types-id-systems
46   Modular Open Source Identity Platform. (n.d.). Country Partners. https://mosip.io/country_partners
47   Macdonald, A. (2024, March 5). Ethiopia, Morocco, Philippines explain MOSIP journeys as platform registers 110M digital IDs. Biometric Update. https://www.biometricupdate.com/202405/ethiopia-morocco-philippines-explain-mosip-journeys-as-platform-registers-110m-digital-ids
48   Omidyar Network India. (n.d.). MOSIP: Open Digital Ecosystem (ODE) Case Study. https://opendigitalecosystems.net/pdf/04_MOSIP-Case-Study_vF.pdf
49   Identification for Development. (n.d.-b). Understanding Cost Drivers of Identification Systems. World Bank. https://id4d.worldbank.org/Cost-Model
50   White, O., Madgavkar, A., Manyika, J., Mahajan, D., Bughin, J., McCarthy, M., & Sperling, O. (2019). Digital Identification: A Key to Inclusive Growth. McKinsey Global Institute. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/digital-identification-a-key-to-inclusive-growth

registration in 12 African countries. Their analysis showed that countries adopting a one-time biometric registration of voters in each election cycle paid $5.10 per voter, while countries adopting a more systematic approach based on continued maintenance paid $1 per voter per election cycle.[51] They estimated that a single-use system costs approximately $23 million, whereas a continuous system costs $7.5 million per cycle. This suggests that a sustainable approach can save up to triple the cost compared to rushed, single-use ID systems. The connection of digital ID and voter registration information remains a matter of controversy and can lead to risks such as disenfranchisement and microtargeting.[52]

The financial sustainability of digital ID systems encompasses a broad spectrum of investments, subsidization, and maintenance costs, contingent upon myriad factors including the system's scope, technology, user base, and country-specific requirements. According to the World Bank, the establishment and upkeep of a digital ID infrastructure can see a significant variation in costs influenced by enrollment procedures, human resources, software development, physical infrastructure required for operation, and procurement processes that can differ from one country context to another.[53] Enrollment costs, for instance, vary based on the biometric technology employed and can elevate the initial expenditure by 20 to 25 percent, with additional biometric data capturing contributing to an increase in human resource expenses by 5 to 15 percent.[54] Furthermore, software customization and data center operations can augment costs by 5 to 10 percent, underscoring the necessity for meticulous planning and optimization to manage expenses effectively.[55]

c. Citizen Impact and Emerging Risks in Digital ID

Digital identity is increasingly being recognized as a public good and is a foundation for digital financial services. Digital authentication of ID is more reliable than visual authentication and can reduce the amount of personal information revealed in a transaction.[56] They can also expand access to other financial services, with accounts being opened within minutes.[57]

However, ID systems, even when digital, do not come into being inside a vacuum. Issuing a new ID requires seeding and the verification of an existing ID, and often requires users to navigate

51 Gelb, A., & Diofasi, A. (2016). Biometric Elections in Poor Countries: Wasteful or a Worthwhile Investment? Center for Global Development Working Paper 435. https://www.cgdev.org/publication/biometric-elections-poor-countries-wasteful-or-worthwhile-investment

52 Jones, P. (2022). Lessons from India's attempt to marry biometric and voter ID databases. Brookings. https://www.brookings.edu/articles/lessons-from-indias-attempt-to-marry-biometric-and-voter-id-databases/

53 Identification for Development (n.d.-b)

54 Identification for Development (n.d.-b)

55 Identification for Development (n.d.-b)

56 World Bank. (2019, August 14). Inclusive and Trusted Digital ID Can Unlock Opportunities for the World's Most Vulnerable. https://www.worldbank.org/en/news/immersive-story/2019/08/14/inclusive-and-trusted-digital-id-can-unlock-opportunities-for-the-worlds-most-vulnerable

57 Appaya, S., & Varghese, M. (2019, June 20). Digital ID – a critical enabler for financial inclusion. World Bank. https://blogs.worldbank.org/en/psd/digital-id-critical-enabler-financial-inclusion

bureaucracies and social structures.[58] Although digital ID is considered here to be the first layer of the stack, it is important to consider that there may be a different sequencing. In Brazil, the adoption of digital IDs followed, and were driven by, digital payments. [59]

Since the introduction of Aadhaar in India in 2009, the mandatory use of the biometric ID by various government and non-government service providers has faced opposition from civil liberty groups regarding privacy and surveillance concerns. In 2018, the Supreme Court of India stated that registering with Aadhaar cannot be considered mandatory. While research on the topic is lacking, news reports have suggested that in practice, Aadhaar is considered de facto mandatory for consumers in India to meet their needs.[60] Users in India do know the importance of their Aadhaar card, but seem to perceive that retrieving their number would be a lengthy process.[61] In reality, help can be obtained through participating banks, post offices, and government offices, or from select private agencies that help service Aadhaar requests. However, some reports suggest that these locations are not sufficiently accessible.[62] Further qualitative research is needed to

understand consumer pain points and how these can be addressed.[63]

Kenya's previous attempt at introducing a digital ID, called the Huduma Namba, was declared illegal by the High Court since it was at odds with Kenya's Data Protection Act.[64] In another attempt to revive the digital ID program, now called Maisha Namba, the government ran into similar challenges and faced a court case for years, ultimately leading them to stop issuing the new IDs. Because of this uncertainty, many young Kenyans —who are the highest users of digital financial services, from using SIM cards to opening bank accounts — are not participating.[65] What has not yet

58 Bailur, S., Pon, B., & Schoemaker, E. (2017). Identities Report. Caribou Digital Publishing. https://www.identitiesproject.com/wp-content/uploads/2017/11/Identities-Report.pdf

59 MacDonald, A. (2022, November 4). Digital version of Brazil's new national identity card now available in some states. Biometric Update. https://www.biometricupdate.com/202211/digital-version-of-brazils-new-national-identity-card-now-available-in-some-states

60 Parsheera, S. (2024). Stack is the New Black?: Evolution and Outcomes of the 'India-Stackification' Process. Computer Law & Security Review, 52. https://www.sciencedirect.com/science/article/abs/pii/S0267364924000141

61 Bailur et al. (2017)

62 Anil, V., & Dreze, J. (2021, July 5). Without Aadhaar, without identity. The Indian Express. https://indianexpress.com/article/opinion/columns/flaw-in-aadhaar-architecture-uidai-card-enrolment-7589155/

63 Bailur et al. (2017)

64 Gakunga, E. (2025, July 18). Kenya's New National Digital ID System Presents Challenges and Opportunities in Equal Measure. Jurist. https://www.jurist.org/commentary/2025/07/kenya-id/

65 Gikunju, W. (2024, February 6). Broken system: Inside Kenya's ID crisis. Nation. https://nation.africa/kenya/news/broken-system-inside-kenya-s-id-crisis-4515168

been researched is the amount of time spent by consumers trying to obtain an ID under Maisha Namba and the pain points of navigating the process.

Digital IDs also can create new vulnerabilities or exacerbate existing ones. This is especially true when states have access to citizens' biometric information and use it to discriminate against specific groups. In the Dominican Republic, people of Haitian ancestry or black-Haitian descended populations were blocked from accessing or renewing their Dominican ID.[66] In the Netherlands, public services only accept digital payments that cannot be accessed without a national digital ID; this results in the exclusion of undocumented migrants who cannot get an ID and therefore cannot get a bank account or pay digitally, and are forced to break the law and ride the public transit system ticketless.[67]

Finally, since IDs are issued to citizens, forcibly displaced persons (FDPs) are among the most vulnerable and count heavily toward the 850 million people globally who are excluded from digital IDs. Challenges faced by FDPs include the lack of officially recognized documents, limited access points to obtain recognized identity documents, limited access points that recognize the ID they might possess, and a focus on anti-money laundering and countering

Digital IDs also can create new vulnerabilities or exacerbate existing ones.

the financing of terrorism (AML/CFT) initiatives, which can deter financial service providers from extending services.[68] FDPs also have unique circumstances and need guardrails to protect their digital ID systems, since they often face discrimination or may be targeted for persecution.[69] There are a few country case studies that indicate how this can be solved at a national level. For instance, Rwanda, Mauritania, and Eswatini have ways to provide digital ID and financial services to FDP populations in their respective countries.[70]

d.   Open Questions on Digital ID

From this research, several outstanding

66 Hayes de Kalaf, E. (2021, August 5). How some countries are using digital ID to exclude vulnerable people around the world. The Conversation. https://theconversation.com/how-some-countries-are-using-digital-id-to-exclude-vulnerable-people-around-the-world-164879

67 Mozilla. (2023, June 20). Voice of financial [in]exclusion [Video]. MozFest House: Amsterdam. https://www.youtube.com/watch?v=9bFwAqL5S8Q

68 Alliance for Financial Inclusion. (2022). Leveraging Digital ID and e-KYC for the Financial Inclusion of Displaced Persons (FDPs). https://www.afi-global.org/wp-content/uploads/2022/07/Leveraging-Digital-ID-and-e-KYC-for-the-Financial-Inclusion-of-Forcibly-Displaced-Persons-FDPs-Risks-and-Opportunities.pdf

69 Alliance for Financial Inclusion (2022)

70 Alliance for Financial Inclusion (2022)

questions remain that warrant further discussion by the inclusive finance community to ensure the digital public infrastructure systems are rolled out responsibly. With regard to identity, remaining questions are classified into the following three categories: governance, innovating for value and long-term sustainability, and citizen/consumer rights and voice (see Table 4).

2.2.2 Digital Payments

TABLE 4: OPEN QUESTIONS AROUND DIGITAL ID

	GOVERNANCE	INNOVATING FOR VALUE AND LONG-TERM SUSTAINABILITY	CITIZEN/CONSUMER RIGHTS AND VOICE
DIGITAL ID	Are governance standards around digital ID well established across all countries?	How do we prevent excessive reliance on or "lock-in" with specific vendors or technology providers?	How do we create guardrails to prevent targeted exclusion and misuse of data by governments and other actors?
	Should we have governance standards for ID use at a global level as countries begin to adopt them, to prevent misuse?	Can the need for digital ID emerge as a use case and therefore see higher adoption driven by the payments layer, as we saw in Brazil?	How do we protect particularly vulnerable groups from being targeted for persecution?
	Is there a way to use open standards so it does not create overreliance on or "lock-in" with a particular vendor or technology (e.g., Open ID and OAuth in identity)?[71]		How can we gain and maintain citizen/user trust to ensure continued usage?
			Within countries that are adopting digital IDs, do we know what it costs consumers to shift from existing ID systems to digital ID systems in terms of time taken, psychological costs, financial payments made to agents, loss of wages, etc.?
			For low digital literacy users, how can retrieval of personal data be made easier and more accessible?

Digital payments are crucial to driving inclusion. Estimates suggest that the widespread adoption of digital payments would add one percentage point to the annual GDPs of mature economies like the United States and at least three percentage points to the annual GDPs of emerging markets.[72] Besides the larger economic impact, research by the Center for Financial Inclusion (CFI) in the wake of the COVID-19 pandemic showed that digital adoption improved the resilience of micro and small businesses[73] and can help in diversifying customer bases since online businesses can reach more markets.[74] At the household level, government-to-person (G2P) payments led to the opening of nearly 865 million accounts during the pandemic, with 49 percent of these accounts
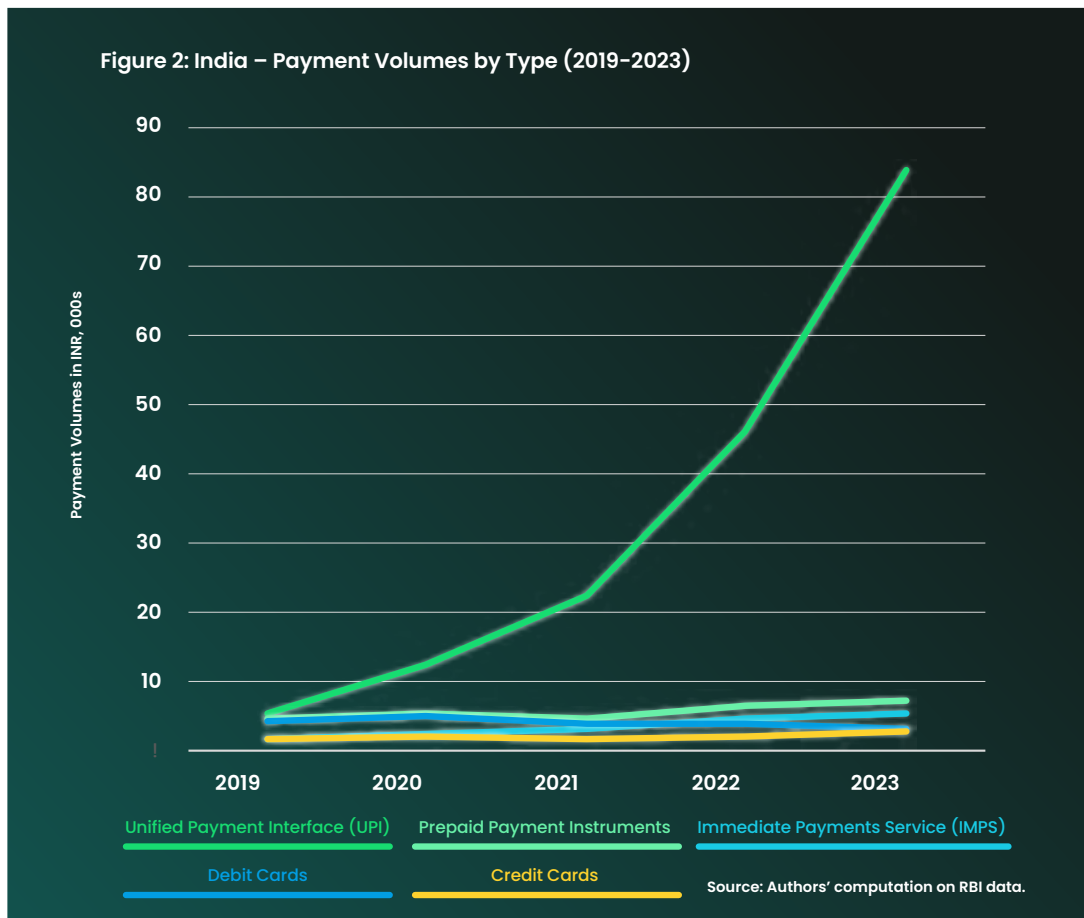
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71 Monetary Authority of Singapore (2019)

72 Payments Leadership Council. (n.d.). What Do Digital Payments Do For An Economy? https://paymentsleadershipcouncil.org/press/what-do-digital-payments-do-for-an-economy/

73 Modi, S., Zapata, K., Braniff, L., & Emig, A. (2021). The Precarious State of MSMEs: Understanding the Impact of COVID-19 and Opportunities to Support their Recovery. Center for Financial Inclusion. https://www.centerforfinancialinclusion.org/the-precarious-state-of-msmes-understanding-the-impact-of-covid-19-and-opportunities-to-support-their-recovery

74 IDB Lab. (2022). Accelerating Digital Payments in Latin America and the Caribbean. World Economic Forum. https://publications.iadb.org/en/accelerating-digital-payments-latin-america-and-caribbean

belonging to women.[75] Digital payments can play a crucial role in both domestic and cross-border remittances[76] and ecommerce payments, can generate better financial health for low-income households and microbusinesses, and can potentially reduce the gender divide.[77]

Figure 2: India – Payment Volumes by Type (2019–2023)

Unified Payment Interface (UPI) Prepaid Payment Instruments Immediate Payments Service (IMPS)
Debit Cards Credit Cards Source: Authors' computation on RBI data.

Some of the most notable examples of payment infrastructures include the UPI in India (see Figure 2) and Pix in Brazil. Other systems such as PayNow in Singapore, PromptPay in Thailand, and PesaLink in Kenya have also been recognized as models of digital payment infrastructure. While these systems vary greatly in terms of governance and structure, they share the common characteristics of offering real-time, peer-to-peer digital payment solutions, aiming at wide acceptance by consumers for small-scale transactions. They also allow users to transact across multiple financial institutions and apps, making them interoperable and thus increasing their value and use. These services are typically provided by central banks, banking associations, or related

75 Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2022). The Global Findex Database: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19. World Bank.
76 Vlaicu, R. (2025, November 29). Leveraging Foreign Remittances for Financial Inclusion. IDB, Ideas Matter. https://blogs.iadb.org/ideas-matter/en/leveraging-foreign-remittances-for-financial-inclusion/
77 World Bank (2025)

entities, reflecting a broad attempt to increase efficiency through multi-stakeholder arrangements. Traditional payment infrastructures, such as the real-time gross settlement (RTGS) have existed for several decades, though they are rarely discussed in the context of DPI. The focus of RTGS on large ticket-size payments and their limited adoption by everyday consumers renders them outside the purview of this discussion.

a.   Governance Approaches to Digital Payments

In the context of fast payment systems, the World Bank identifies three core roles for the management and implementation of infrastructure: overseers, owners, and operators, each of which is essential for effective governance and operation.[78] Examples show that there can be varied approaches to governance across different jurisdictions with the same player performing more than one role in a country context (see Table 4 below), emphasizing that there is no one-size-fits-all approach for the successful implementation and operation of fast payment systems.

TABLE 5: ROLES IN PAYMENT SYSTEMS ACROSS VARIOUS COUNTRIES

COUNTRY	SYSTEM	OWNER	OPERATOR	REGULATORY/ SUPERVISORY AUTHORITY
INDIA	Immediate Payment Service (IMPS) and Unified Payments Interface (UPI)	National Payments Corporation of India (NPCI)	National Payments Corporation of India (NPCI)	Reserve Bank of India (RBI)
SINGAPORE	Fast and Secure Transfers (FAST)	Singapore Clearing House Association, which includes the Monetary Authority of Singapore (MAS) and major commercial banks	Banking Computer Services Pvt. Ltd.	MAS
THAILAND	PromptPay	National ITMX	National ITMX	Bank of Thailand (BOT)
KENYA	PesaLink	Kenya Bankers Association	Integrated Payment Services Ltd.	Central Bank of Kenya
BRAZIL	Pix	Banco Central do Brasil (BCB)	Banco Central do Brasil (BCB)	Banco Central do Brasil (BCB)

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78   This section largely borrows from World Bank (2021), Considerations and Lessons for the Development and Implementation of Fast Payment Systems, at https://fastpayments.worldbank.org/sites/default/files/2021-11/Fast%20Payment%20Flagship_Final_Nov%201.pdf

Digital payment systems, while fast, require a range of actors at the backend. Unlike a cash transaction between a buyer and seller where legal tender or currency is handed over and the transaction ends, online transactions between a business and customer require several actors. Online transactions include the customer, the customer's bank (card issuer), the business, the business's bank (acquirer), the payment gateway, the payment processor, and the card network. Other than the consumer, each of the other players assumes a cost and credit risk, for which they are compensated through any charged fees. In the UPI case, counterparties include the customer, the customer's issuing bank, the merchant, the merchant's acquiring bank, and the payment service provider — in the case of the latter, a large market share belongs to fintechs like PhonePe and Google Pay.[79]

In Brazil, Banco Central do Brasil (BCB) created Pix,[80] an instant payment program that allows for transfer of funds between all transactional accounts — demand, savings, and prepaid payment accounts. The systems allow users — people, companies, or governmental entities — to send or receive payment transfers in seconds, at any time, and at low cost (and free for individuals), using either a QR code or a Pix alias. BCB has authorized all financial and payment institutions that are licensed to offer transaction accounts to participate in

> Digital payment systems, while fast, require a range of actors at the backend.

Pix. Specific conditions govern payment institutions that are not authorized by BCB to also participate in Pix. Launched in 2020, Pix has become the fastest growing payment system in the world, serving over 140 million people — almost two-thirds of Brazil's population — and processing more than 5 billion transactions per month.[81]

Pix is often spoken about in the same breath as India's Unified Payment Interface (UPI) as two prominent success stories; however, the two systems are designed differently and began with different objectives.[82] This difference in objectives leads to variations in outcomes measured as success, design of systems, and incentives.

These governance objectives matter since one could argue that the National Payments Corporation of India (NPCI)'s role in the ownership and operation of UPI as a consortium of incumbent banks and structured as a nonprofit can act as a deterrent to long-term innovation and promoting competition.[83] With inclusion as the agenda, the focus has been on

79   Krishnamurthy, A. (2020, February 5). Government's Zero MDR Policy Could Kill Digital Payments in India. Medium. https://medium.com/in-tech/governments-zero-mdr-policy-could-kill-digital-payments-in-india-977e6fdc77bf

80   Banco Central do Brasil. (n.d.). Brazilian Payments System: Pix. https://www.bcb.gov.br/en/financialstability/pix_en

81   Johnson, T. (2025, September 21). An instant payments revolution started in Brazil. Fiserv. https://www.fiserv.com/en/insights/articles-and-blogs/an-instant-payments-revolution-started-in-brazil.html

82   Eaves, D., & Kedia, M. (2025). Exploring Different Financing Models for Digital Public Infrastructure and Why They Matter. T20 Policy Brief. https://www.orfonline.org/wp-content/uploads/2025/06/T20_PolicyBrief_TF2_215_FinancingModels-DPI.pdf

83   Rajagopalan, S. (Host). (2024, February 8). Rahul Matthan on AI, Privacy, and Digital Public Infrastructure [Podcast episode]. In Ideas of India. Mercatus Original Podcasts. https://www.mercatus.org/ideasofindia/rahul-matthan-ai-privacy-and-digital-public-infrastructure

reducing the merchant discount rate (MDR) to zero, rather than allowing competition and discovery of price through market forces. On the other hand, Banco Central do Brasil (BCB) designed Pix so that any institution offering digital payments, whether traditional bank, neo-bank, fintechs, finance companies, credit cooperatives, and others, could participate, thus presenting competition and an incentive to delivery high quality at lowest prices to the consumer.[84] We argue that outcomes from participation in formal financial services should be designed beyond inclusion and to foster greater trust, offer choice and quality financial services to consumers that help them lead better lives. We summarize these in Table 6 below.

TABLE 6: COMPARING UPI AND PIX[85]

	UPI (INDIA)	**PIX (BRAZIL)**
LAUNCH GOAL	Accelerate adoption of digital payments and drive inclusion	Catalyze market competition and innovation in digital payments
FUNDED AND SUPPORTED BY	Consortium of banks (National Payments Corporation of India (NPCI))	Banco Central do Brasil (Central Bank of Brazil)
PRICING	MDR is waived for UPI users	Transaction fee for merchant transactions (free for individuals)
USER ACCESS	Payment apps (e.g., PhonePe, Paytm, Google Pay)	Directly from banking/financial apps
OFFLINE PAYMENTS	Yes (UPI123PAY)	Part of future vision, not yet developed

When speaking of fast payment systems, it would be remiss to not cover open payment systems like Mojaloop. Going back to the two boundary criteria for DPI, Mojaloop can be classified as, and has been recognized to be, a digital public good (DPG).[86] In Africa, countries like Uganda[87], Tanzania[88] and Rwanda[89] are looking to open-source software (OSS) systems, such as Mojaloop,[90] to develop interoperable digital payments

84 Banco Central do Brasil. (2025). Pix Management Report: Conception and first years of operation 2020-2022. https://www.bcb.gov.br/content/estabilidadefinanceira/pix/relatorio_de_gestao_pix/pix_management_report_2025.pdf

85 Eaves and Kedia (2025)

86 Porteous (2025)

87 Khairnar, S. (2022, July 15). Mojaloop: the open source software powering payments for the unbanked. Fintech Futures. https://www.fintechfutures.com/2022/07/mojaloop-the-open-source-software-powering-payments-for-the-unbanked/

88 Mirondo, R. (2022, January 7). New Bank of Tanzania payment system set for February roll-out. The Citizen. https://www.thecitizen.co.tz/tanzania/news/business/new-bank-of-tanzania-payment-system-set-for-february-roll-out-5673110

89 Haley, S. (2025, August 5). Mojaloop's New System Integrator Accelerator Program Scores a Win. Mojaloop Foundation. https://mojaloop.io/mojaloops-new-system-integrator-accelerator-program-scores-a-win/

90 Allcock, S. (2025, September 29). Co-Develop Invests in Mojaloop Foundation to Drive Open Source Instant Payment Solutions in Africa. Business Mole. https://www.businessmole.com/co-develop-invests-in-mojaloop-foundation-to-drive-open-source-instant-payment-solutions-adoption-in-africa/

ecosystems, which can expedite deployment of payment systems, reduce barriers to entry, and reduce transaction costs significantly — a use case that could transition Mojaloop to be considered a DPI from a DPG.[91]

b. Innovating for Value and Long-Term Sustainability

Subsidization of digital payments has emerged as a pivotal yet controversial strategy in the drive toward enhanced financial digitization globally. While subsidies have undeniably accelerated the adoption and usage of digital payment systems, ultimately fostering financial inclusion and reducing reliance on cash transactions, they also raise significant concerns regarding market distortion and long-term financial sustainability.

In India, the exponential growth of UPI has been accompanied with increased expectation for continued government subsidies. In a strategic move to escalate digital payment adoption, the Indian government eliminated the merchant discount rate (MDR) for UPI and RuPay transactions in 2020, a fee traditionally levied on merchants by banks and payment service providers for digital transactions.[92] In 2022, the government allocated just over 2,000 crore Indian rupees (approximately US$250 million) as a subsidy to banks and select fintech companies, acknowledging their role in maintaining the public service of digital payments.[93] What remains unclear is how this subsidy was calculated and allocated, and it merits further research to understand how the adoption of future subsidies may encourage the uptake of services.

91 Allcock (2025)

92 Sood, N. (2024, January 31). Budget 2024: Fintechs pin hopes on continued subsidy for UPI transactions. MoneyControl. https://www.moneycontrol.com/news/technology/budget-2024-fintechs-pin-hopes-on-continued-subsidy-for-upi-transactions-12158491.html

93 The Economist. (2022, May 15). A Digital Payments Revolution in India. https://www.economist.com/special-report/2023/05/15/a-digital-payments-revolution-in-india

Offering subsidies, however, is not a strategy common to all digital payments systems, although some countries have received donor grants or support from the World Bank. No known subsidies were provided to other digital payments programs such as PromptPay and PayNow. Pix in Brazil, for instance, has also not benefited from direct government subsidies, and banks typically charge merchants for payments, although consumers typically do not face any costs. A study by the Bank of International Settlements argues that Pix transactions in Brazil offer a significantly lower cost to merchants, averaging 0.22 percent — this is a stark contrast to the higher fees associated with card payments (e.g., 2.2 percent for credit cards within Brazil, 1.7 percent in the U.S., 1.5 percent in Canada, and 0.3 percent in the European Union).[94] However, this comparison between instant payment system charges and credit cards may not be altogether accurate since credit cards offer higher consumer protection measures in the form of chargebacks, which are missing as a feature in instant payment systems. A part of the fees is also used to continuously upgrade the protocols to keep them secure, which in turn protects users and allows access to better quality systems. Finally, consumers should have the agency to choose and pick the system that delivers the best services rather than be mandated to use a system that incentivizes usage based on lowest cost,

which is not sustainable in the long run. With instant payment systems, we are in the early days, and long-term outcomes for market structure, competition, and innovation are yet to be determined.

Enhancing the value of innovation fundamentally hinges on establishing a framework that facilitates collaboration, coordination, and co-investment among multiple stakeholders.[95] Emerging evidence indicates that the payments layer of DPI can benefit from early-stage co-creation and participation, facilitated by institutional collaboration mechanisms that engage public, private, and civil society actors from the outset.[96] Brazil's Pix illustrates this co-creation approach, with the Central Bank establishing the Pix Forum, a collaborative governance body that includes over 150 members like banks, credit card operators, and civil society groups to develop an instant payment system.[97] Another example of public-private collaboration comes from PromptPay in Thailand, where National ITMX is the owner and operator of PromptPay, Bank of Thailand acts as the supervisor, and National ITMX collaborated with Vocalink, a Mastercard company, for system development.[98]

c.   Citizen Impact and Emerging Risks in Payments DPI

In the shift toward a digital-first payment infrastructure, the emphasis on convenience and accessibility has inadvertently led to a decline in

94   Duarte, A., Frost, J., Gambacorta, L., Koo Wilkens, P., & Shin, H. (2022). BIS Bulletin 52: Central banks, the monetary system and public payment infrastructures: lessons from Brazil's PIX. BIS. https://www.bis.org/publ/bisbull52.pdf
95   Eaves et al. (2024)
96   Eaves et al. (2024)
97   Eaves et al. (2024)
98   World Bank. (2021). World Bank Fast Payments Toolkit – Case Study: Thailand [PowerPoint slides]. https://fastpayments.worldbank.org/sites/default/files/2021-09/World_Bank_FPS_Thailand_PromptPay_Case_Study.pdf

investments in consumer protection and trusted design. This shift has, in some scenarios, created a fertile ground for increased fraud and crime associated with new technologies.

For instance, various experts and bankers in India have pointed out that the approach of not charging fees for digital transactions in India also has its drawbacks. The lack of revenue has led to many banks' and fintech companies' reluctance to invest in consumer protection components. Financial services providers highlight various costs involved — including technology, maintenance, and the handling of fraud and disputes — and question the viability of bearing these costs without any incoming revenue. Ajay Shah, from the Mumbai-based think tank XKDR Forum, and Raghuram Rajan, a former governor of the RBI, both suggest that this situation raises the need to reconsider pricing models. Rajan proposes that a potential solution could be to introduce a nominal fee that would ensure sustainability and cover operational costs.[99]

The widespread adoption of instant payments has also caused an increase in scams and opportunities for crime. This has forced regulators and industry players to limit functionalities and identify mitigating strategies. Australia, for example, has adjusted its real-time

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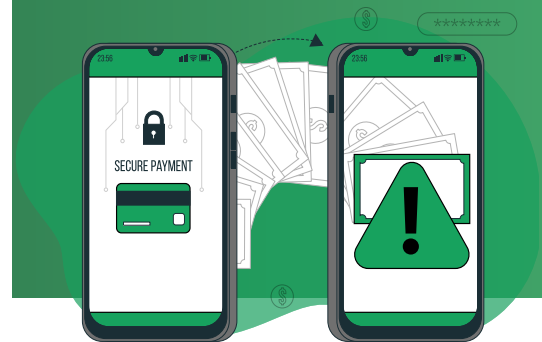
payment system to counteract the rise in financial scams by slowing down transactions for enhanced security and to tackle the rising tide of scams.[100] A study by Indian economist Renuka Sane highlighted customer dissatisfaction with UPI by revealing that 18 percent of users reported issues such as fraud or accidental payments, with less than a third seeing their problems resolved.[101] Brazil implemented restrictions on the size of nighttime PIX transfers to combat people being "lightning kidnapped," i.e., snatched off the streets and forced to transfer large amounts.[102]

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99   The Economist (2022)

100   Yeates, C. (2025, April 26). Banks put in 'speed bumps' as they fight a surge in scams. The Sydney Morning Herald. https://www.smh.com.au/business/banking-and-finance/digital-payments-need-speed-bumps-to-counter-scam-surge-nab-20250419-p5d1mv.html

101   Balasubramaniam, V., Gawali, A., Sane, R., & Sharma, S. (2022, December 28). Examining grievances and redress for banking products. The Leap Journal Blog. https://blog.theleapjournal.org/2022/12/examining-grievances-and-redress-for.html#gsc.tab=0

102   Financial Times. (2021, September 5). Brazil's criminals turn to flash kidnapping as they take advantage of new tech. https://www.ft.com/content/225fd97c-ef82-4dfa-b09b-97b1671e1e00

As developing countries continue to explore adopting DPI, it is crucial that they recognize the associated risks and unintended consequences of subsidization on investments in consumer protection. The experiences from countries like India and Brazil underscore the importance of balancing the benefits of digital payments with the need for robust consumer protection measures and a sustainable financial model. On the payments front, a set of principles that help guide responsible deployment and user centricity have emerged with the Responsible Digital Payments guidelines.[103] However, payments are not an end in themselves. Digital payments generate data trails that can be used to develop and deliver suitable financial products to consumers, which holds potential for better services but also presents risks of data privacy, security, and safe data exchange mechanisms.

d.   Open Questions on Payments DPI

In reviewing the foundational elements of DPI for financial inclusion, open questions regarding the payment layer of DPI are classified into four categories: governance, innovating for value and long-term sustainability, citizen/consumer rights and voice, and outcomes.

TABLE 7: OPEN QUESTIONS AROUND DIGITAL PAYMENTS

	GOVERNANCE	INNOVATING FOR VALUE AND LONG-TERM SUSTAINABILITY	CITIZEN/CONSUMER RIGHTS AND VOICE	OUTCOMES
DIGITAL PAYMENTS	→ What governance mechanisms can create incentives for innovation and broader participation by multiple stakeholder groups and generate value for end users?	→ How do we ensure there are sufficient incentives to innovate? → How do we ensure it generates value for consumers, firms, and society? → How should costs of ongoing upgrades to maintain secure systems be covered? → How do we ensure it generates value for consumers, firms, and society?	→ What do robust grievance redressal mechanisms look like, particularly in markets with limited guardrails or low digital literacy, to maintain and build trust in the system?	→ Is there systematic research to understand the impact on consumer protection? → What metrics would help us understand positive or negative outcomes on consumers, as well as identify emerging fault lines in time? For instance, assessing inclusion of individuals and firms, greater choice and impact of increased competition, etc.? → How do we go beyond measuring access to usage, financial well-being, and financial health impacts of these systems?

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103   Better Than Cash Alliance. (2024). UN Principles for Responsible Digital Payments. https://responsiblepayments.org/pdfs/UN-ResponsiblePayments.pdf

2.2.3 Consent-Based Data Exchange

Integral to the functioning of DPI is a data exchange system that facilitates the secure sharing of information between consumers as well as the private and public sector. In Estonia, for instance, the X-Road open software facilitates multiple databases and information systems to communicate across health, mobility, and education sectors, among others. In India, account aggregators (AAs), a set of RBI-licensed data intermediaries that operate within India Stack, facilitate consent-based retrieval and sharing of data from financial institutions to other authorized parties.

From a financial inclusion perspective, data exchange is crucial in moving the needle, whether from earlier efforts of positive credit reporting or more recent innovations in open banking and finance. Data exchange can improve financial products and services that target underserved groups as well as empower consumers and businesses to enhance their financial behavior. Additionally, innovations in data exchange models beyond finance, in sectors including ecommerce, agriculture, and trade, have significant potential for financial inclusion. For example, Agri Stack in India is fostering innovation in agriculture, while ONDC and SGTraDex are leading the way in ecommerce and trade/logistics, respectively. These exchanges dig into sectors and consumers with thin or non-existent financial data trails, and have strong

potential to boost economic inclusion, though most are at a nascent stage.[104]

a. Governance of Data Exchange

Considering the intricate nature and associated risks of exchanging sensitive consumer financial data, coupled with the challenge of aligning participation incentives between large incumbent financial institutions, which frequently have little motivation to share data, and smaller entities and fintechs, which stand to gain significantly from open banking, the importance of governance choices and arrangements cannot be overstated.

There are several dimensions of governance that must be considered, including the architecture of data sharing, technical and commercial standards, participation eligibility, and the varied approaches to open banking. While this paper does not delve into detailed discussions of each domain, it is crucial to grasp the complexities these governance decisions entail, as they significantly influence market outcomes and consumer impacts. The following four dimensions should be taken into account:

1. **Regulator vs. Market-Driven:** The features of open banking initiatives differ depending on whether they are regulatory-based mandates or market-led initiatives. The European Union and Brazil, for example, have mandated open banking through laws and regulations, while Singapore has opted for a partnership-driven

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104   Totolo, E. et al. (2024). Beyond Silos: Frontiers of Data Sharing and Implications for Financial Inclusion [Unpublished]. Center for Financial Inclusion.

"organic" model without specific legislation or licensing frameworks. India has prioritized a "technology-first" strategy, focusing on the development of DPI. Beyond these overarching policy approaches, there are notable differences in the details of their open banking ecosystems, including licensing requirements, data sharing architectures, standards for technical and legal compliance, incentives for participants, and the business models of third-party providers (TPPs).

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2. **Harmonization of Technical and Commercial Standards:** Effective data exchanges thrive in contexts where the information, rules, and standards have achieved a high degree of standardization. The robustness of data exchanges relies on the interoperability of data, which in turn impacts the extent to which actors need to incur additional costs to make the data usable for commercial purposes.[105] In markets such as the European Union with PSD2, industry groupings have spearheaded standardization efforts when they were not mandated by regulation. Even when standards exist, compliance can face challenges, particularly from incumbent players who struggle or may not be inclined to update legacy systems.

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105   Totolo et al (2024)

3. **Data Protection and Security:** For consumers and businesses to participate in data exchanges, trust is key. Data exchanges will be trusted and utilized when information is accurate and secure and when consumers understand what will happen to their data. Research in the European Union showed that the highest predictor of interest in open banking was whether respondents felt that their data would be secure and kept private.[106] Personal data protection is a serious issue worldwide. The risks arise not just from those committing blatant data theft for identity and fraud purposes, but particularly from an ongoing lack of proper policy safeguards and the lack of enforcement of those policies. One source of data risk involves inadequate safeguards for users, especially low digital literacy users, to retrieve their personal information. The Aadhaar identity system in India is justifiably lauded in its breadth of coverage, but it has suffered from administrative problems in how difficult it is for users to fix incorrect data or retrieve lost account numbers. A fragmented data ecosystem also lends itself to greater vulnerabilities to cyberattacks, further impacting security and consumer protection risks.

4. **Data Localization:** As part of their data protection regulation, some countries have imposed data localization regimes, where countries constrain or outright ban the flow of specific types of data outside of their borders. As of November 2023, approximately 60 countries had one or more types of these restrictions in place.[107] While they are often framed as supporting national sovereignty or preventing digital harm, in practice they can impose real costs on the market and a "tax" on low-income individuals.[108] Most directly, data localization restricts access to global cloud computing services, which increases the costs for providers. These costs can be transferred to consumers or could lead to increased costs due to decreased competitiveness, potentially even dissuading a fintech provider from entering a given market or catering to a market segment.[109]

b. Innovating for Value and Long-Term Sustainability

In the evolving landscape of data exchange, intermediaries play a pivotal role in organizing data, matching providers with users, and facilitating transactions. These entities not only serve as connectors within data ecosystems but also enhance the utility of data for end users through processing and data analysis tools.

106 Polasik, M., & Kotkowski, R. (2022). The Open Banking Adoption Among Consumers in Europe: The Role of Privacy, Trust, and Digital Financial Inclusion. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4105648

107 U.K. Government's International Data Transfer Expert Council. (2023). Towards a Sustainable, Multilateral, and Universal Solution for International Data Transfers. U.K. Department for Science, Innovation & Technology. https://assets.publishing.service.gov.uk/media/65734b2f33b7f2000db72155/towards_a_sustainable_multilateral_and_universal_solution_for_international_data_transfers.pdf

108 Medine, D. (2024). Data Localization: A "Tax" on the Poor. Center for Global Development, Working Paper 674. https://www.cgdev.org/sites/default/files/data-localization-tax-poor.pdf

109 Medine (2024)

Several markets have developed vibrant ecosystems for third-party providers, such as account aggregators and payment initiation providers, but these are still at an early stage in identifying viable business propositions. In India, recent evaluations highlight a trend of increasing competition and declining prices among account aggregators. While official data on this phenomenon is scarce, analyses by Indian media outlets have raised questions about the long-term viability of these business models. Given the transaction volumes recorded thus far, achieving financial sustainability for aggregators appears challenging without first diversifying revenue sources.

In the European Union, there is a rich diversity of TPPs in the open banking sector. However, the number of TPPs decreased for the first time in 2023 since the implementation of PSD2. This reduction is attributed to a combination of factors, including market consolidation through mergers and the heightened competition that defines the sector. Despite the influx of venture capital in recent years, which has injected dynamism into the market, the future commercial viability of TPPs remains clouded with uncertainty. "Premium APIs" have been proposed as a potential revenue source by a group of major European banks including HSBC and Grupo BBVA. Under this arrangement, banks could charge for value-added services such as dynamic recurring payments, which go beyond data sharing requirements in PSD2.[110]

c. Citizen Impact and Emerging Risks in Data Exchange

The sharing of personal and financial data comes with risk. Recent media reports have discussed the practice in some countries of governments using access to personal data for surveillance and monitoring purposes. One recent report looked at instances of privacy laws in Africa failing to protect people in the face of increasing government surveillance.[111] In Afghanistan, there are growing concerns about Taliban use of biometric data to determine which Afghans helped the U.S.[112] These risks increase with user vulnerability. Rohingya refugees in Cox's Bazar, Bangladesh, have been targeted by police for posting on social media.[113]

Finally, data protection concerns don't just arise because of individual data breaches or government overreach. Corporate use of personal data is a massive global business, with companies monitoring consumer behavior to sell consumer attention to advertisers, as well as drive competitors and other innovators away. Data-driven behavioral manipulation is increasingly being used to influence consumer decision making in

110 The Paypers. (2023, December 7). The resurgence and future prospects of the SPAA scheme. https://thepaypers.com/expert-opinion/the-resurgence-and-future-prospects-of-the-spaa-scheme

111 Institute of Development Studies. (2021, October 21). State surveillance of citizens going unchecked across Africa. https://www.ids.ac.uk/news/state-surveillance-of-citizens-going-unchecked-across-africa/

112 Sankaran, V. (2021, August 25). Taliban likely to have access to biometric databases of Afghan civilians who helped US. Independent. https://www.independent.co.uk/tech/taliban-afghanistan-biometric-databases-us-b1908512.html

113 Human Rights Watch. (2023, January 17). Bangladesh: Rampant Police Abuse of Rohingya Refugees. https://www.hrw.org/news/2023/01/17/bangladesh-rampant-police-abuse-rohingya-refugees

ways that may not reflect the consumer's best interest or safety. All these behaviors can drastically impact consumers' ability to trust and share their data.

d. Open Questions in Data Exchange

Table 8 includes some of the open questions related to data exchange, a layer of DPI that is still evolving in its use cases.

TABLE 8: OPEN QUESTIONS AROUND DATA EXCHANGE

	GOVERNANCE	INNOVATING FOR VALUE AND LONG-TERM SUSTAINABILITY	CITIZEN/CONSUMER RIGHTS AND VOICE	OUTCOME MEASUREMENT
DATA EXCHANGE	→ What kind of governance mechanisms need to be in place to empower users, especially the most vulnerable? → Who designs rules for data exchange and who is responsible for ongoing audit of systems? → How do we build supervisory capacity in various nations? → How do we ensure innovation continues and future elements of the DPI ecosystem converge to create value, e.g., data, protocols, applications, etc.?	→ Is there a need for systematic research to ensure use cases of innovation are documented and disseminated across countries?	→ How can data sharing and exchange initiatives that are part of DPI be optimized, perhaps across sectors and national borders, to better serve financially excluded or underserved communities, including migrants, refugees, and informal businesses?	→ How can we understand better how vulnerable groups such as migrants, refugees, and forcibly displaced persons interact with digital infrastructure

03 Toward Responsible DPI

For a public system to truly work and deliver the benefits it promises, it must include all people. This includes people who lack digital access and may not have strong digital capabilities. While the COVID-19 pandemic broadly accelerated internet access around the world, access was uneven, especially among developing countries. Access disparities are particularly glaring along gender and geography. Globally, in 2022, 57 percent of women used the internet as compared to 62 percent of men. However, only 19 percent of women in least developed countries (LDCs) used the internet in 2020, compared to 86 percent of women in advanced economies in 2019.[114] This disparity is fueled in part by the mobile phone ownership gap, which remains unchanged in LMICs at approximately 17 percent.[115] Even when mobile ownership exists, other infrastructure and affordability challenges can create a gap between rural and urban areas. For instance, globally, internet usage in urban areas stands at 81 percent compared to 50 percent in rural areas.[116] Affordability of internet services plays a role in this; research indicates that only 17 percent of the population in Africa can afford

114 International Telecommunication Union. (2025, November). Bridging the gender divide. https://www.itu.int/en/mediacentre/backgrounders/Pages/bridging-the-gender-divide.aspx

115 GSMA. (2025). The Mobile Gender Gap 2025. https://www.gsma.com/r/gender-gap/

116 ITU. (2025). Facts and Figures 2025: Internet use in urban and rural areas. https://www.itu.int/itu-d/reports/statistics/2025/10/10/ff25-internet-use-in-urban-and-rural-areas/#:~:text=Worldwide%2C%2081%20per%20cent%20of%20urban%20dwellers%20use,from%2071.7%20in%202020%20to%2081.6%20in%202025

1 GB of data, compared to 57 percent in LAC and 47 percent in Asia.[117]

If new DPI programs fail to meet the needs of vulnerable communities, especially women, it will merely exacerbate existing inequalities and perpetuate fragmentation. It is also important to note that if redressal systems fail or if civil liberties are at risk from using the infrastructure, it will only further erode trust in DPI systems. All three layers — ID, payments, and data exchange — are crucial for the safe and secure exchange of digital data and therefore are "applied examples of trust frameworks."[118] For people to trust digital financial services delivered using DPI, it is crucial to build appropriate guardrails while promoting innovation and to build systems that benefit users. Furthermore, it is essential that the sector can measure these benefits.

After raising open questions associated with each of the three elements, the next section examines the combination of the three elements through a systemic lens and identifies persistent open questions.

3.1 Measuring Consumer Outcomes

While DPI has been largely acknowledged as important to achieve positive consumer outcomes, it is important to first collectively agree on metrics that would prove these positive results before admitting success. Early

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> For people to trust digital financial services delivered using DPI, it is crucial to build appropriate guardrails while promoting innovation and to build systems that benefit users.
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reports acknowledge progress made toward increasing access to digital IDs and payments. For instance, India has provided access to over a billion digital IDs, and the Global Findex 2021 showed that 57 percent of people in developing economies made or received a direct payment digitally in 2021, compared to 35 percent in 2014.[119] However, most of the sought impact is still a potential impact, and the current metrics collected do not help in measuring progress toward the intended goal.[120]

The pandemic catalyzed the use of digital payments when governments used them extensively to deliver benefits. While this is an important first step, reports on social assistance transfers caveat that demand-side evidence is unclear, and in particular, there is a need for further research on the beneficiary experience and the magnitude of exclusion.[121] The argument

117 OECD. (2021). Key Messages: EMNet Working Group – Digital Transformation in Emerging Markets. https://www.oecd.org/dev/KeyMessages_Digital_Transformation_Emerging_Markets.pdf
118 Porteous (2025)
119 World Bank. (2023, February 2). Latest Global Findex Data Chart 10 Years of Progress in Financial Inclusion. https://www.worldbank.org/en/news/feature/2023/02/02/latest-global-findex-data-chart-10-years-of-progress-in-financial-inclusion
120 United Nations Development Programme. (2023, July 15). The Human and Economic Impact of Digital Public Infrastructure. https://www.undp.org/publications/human-and-economic-impact-digital-public-infrastructure
121 Gelb, A., & Mukherjee, A. (2020). Digital Technology in Social Assistance Transfers for COVID-19 Relief: Lessons from Selected Cases. Center for Global Development. https://www.cgdev.org/sites/default/files/digital-technology-social-assistance-transfers-covid-19-relief-lessons-selected-cases.pdf

of measuring the impact of digital infrastructure to mitigate risks is not new, and recent publications note several challenges, including the absence of systematic methods, metrics, and tools to measure progress.[122] Figure 3 outlines areas where indicators exist and where further work is needed.[123] It should be noted that while there may be indicators[124] to measure outcomes like trust in financial services, such as the Tufts Digital Intelligence Index trust indicators or the Edelman Trust Barometer,[125] this does not mean the desired outcomes are positive. Evidence of waning trust can also be seen in declining usage in various instances. We also argue that desired outcomes for households should include financial health and security, of which resilience is a crucial component.

FIGURE 3: DPI INDICATORS: WHAT EXISTS AND WHAT NEEDS TO BE COLLECTED?[126]
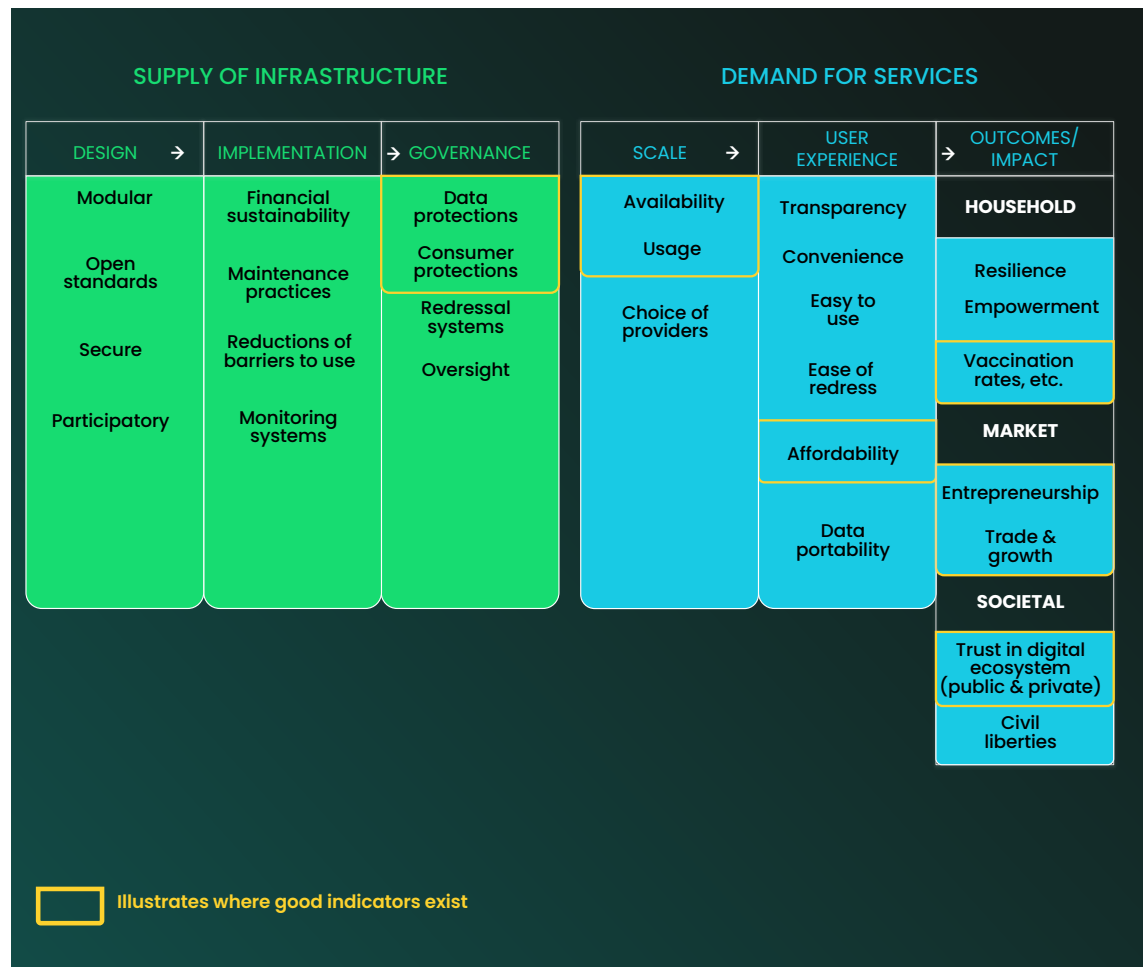
Source: Vora and Dolan (2022)

122 Vora, P., & Dolan, J. (2022). What is 'good' digital infrastructure? Measuring digital infrastructure to maximize development outcomes and mitigate risks. Brookings Global Working Paper 167. https://www.brookings.edu/wp-content/uploads/2022/02/Good-Digital-Infrastructure.pdf

123 Vora and Dolan (2022)

124   Digital Planet. (n.d.). Digital Intelligence Index. The Fletcher School at Tufts University. https://digitalintelligence.fletcher.tufts.edu/trust/overview

125 Edelman. (2024). Trust Barometer. https://www.edelman.com/trust/2024/trust-barometer

126   Vora and Dolan (2022)

Acknowledging that the sector is still at an early stage in measuring impact is an important first step. But the next step is to collectively agree on what needs to be measured and how to design systems to obtain the data necessary to measure outcomes beyond availability and usage.

This raises the first set of key questions in creating a roadmap to responsible DPI:

→   What should we measure?

→   Do we have the systems and processes to collect this data?

→   How do we get there?

3.2 Building a Path Forward

There are multiple stakeholders with an interest in supporting DPI, not just for mobilizing finance but also with tech support, capacity building, research, and advocacy. Donor national governments as well as multilateral banks and philanthropic organizations play a critical role in how DPI will develop in the coming years, while research and advocacy organizations are key voices in promoting the concept and benefits of DPI. Of course, national and local governments, the private sector, and community organizations are also focal players in this discussion. However, there's been little coordination to date between these parties, given their different mandates and operating styles. The likelihood of achieving formal coordination may be low, but there is scope for improved communication,

interaction, and peer learning, as well as eliminating unnecessary overlap and contradictory messaging. The question is how this community goes about doing so.

3.2.1 Steps Toward Responsible DPI

Thus far, some of the key recommendations for responsible DPI have called for regular conversations among all stakeholders involved to assess the pros, cons, and limitations.[127] Technology developers are called upon to better understand user needs and ensure accessibility by a variety of users, in part by actively consulting with end user advocates. Policymakers are asked to better integrate deliberation into the design and deployment of DPI

127   Omidyar Network. (2021, August 31). The growing demand for digital public infrastructure requires coordinated global investment and an ethical lens. Medium. https://medium.com/omidyar-network/the-growing-demand-for-digital-public-infrastructure-requires-coordinated-global-investment-and-an-8ce1a22e4d6c

by bringing in the voices of historically marginalized groups.[128] Once deployed, digital systems need to be regularly evaluated to assess the impact on communities they serve so that policymakers can take steps to reform or correct systems, protect user rights, and establish greater transparency and accountability for all stakeholders.[129] In addition, philanthropic funders should identify and support avenues for capacity building for DPI development[130] and deployment.

Furthermore, it is also critical to develop proper safeguards around DPI and to provide effective oversight and transparency tools to ensure DPI works for all people.[131] This would begin with a user-centric lens and include: testing frameworks against best practices; developing scorecards to check if countries are improving their DPI systems; creating a global governance mechanism and creating global suptech[132] tools to monitor issues like complaints, market surveyance, or identity misuse, along with market conduct tools in the form of mystery shoppers; and developing data rights tools. The goal is to mainstream a rights-based approach and conduct ongoing ethnographic research to understand how DPI benefits and/or harms specific communities.

One relevant effort is the recently announced initiative from UNDP and the UN Tech Envoy's Office to develop the Universal Safeguards Framework for Digital Public Infrastructure.[133] Another group, Open Digital Ecosystems, has defined 15 guiding principles for responsible DPI systems with a "strong emphasis on strengthening DPI through citizen-centric design and safeguards, sustained community engagement, institutional capacity building, and robust governance." [134] The group says that "to maximize the benefits of DPI for the provision of citizen-centric services, and minimize risks and potential harms, the 'non-tech' layers of institutions, legal and regulatory frameworks, and communities are equally, if not more, important than robust technology solutions."[135]

The importance of community involvement and influence in DPI is not just an abstract concern. One study, the Last Mile Access Study,[136] looked at the ability of citizens to access government services, and found that even when digitized, people lacked awareness and had little ability to navigate such services. People still relied on others in their community for in-person support with using DPI services. As the study

128 Omidyar Network (2021)

129   Omidyar Network (2021)

130   Omidyar Network (2021)

131   McGowan, K., & Vora, P. (2023, November 9). The promise of DPI won't be realized with good design alone. Safeguards are key. Digital Impact Alliance. https://dial.global/promise-of-dpi-good-safeguards-key/

132   BIS. (n.d.). BIS Innovation Hub work on suptech and regtech. https://www.bis.org/about/bisih/topics/suptech_regtech.htm

133   United Nations Development Programme. (2023, September 17). UN Tech Envoy and UNDP launch initiative to ensure that digital infrastructure turbocharges the SDGs safely and inclusively [Press release]. https://www.un.org/techenvoy/sites/www.un.org.techenvoy/files/Press_Release_SafeDPI_0.pdf

134   Open Digital Ecosystems. (n.d.). Principles for Responsible ODEs. https://www.opendigitalecosystems.net/principles.html
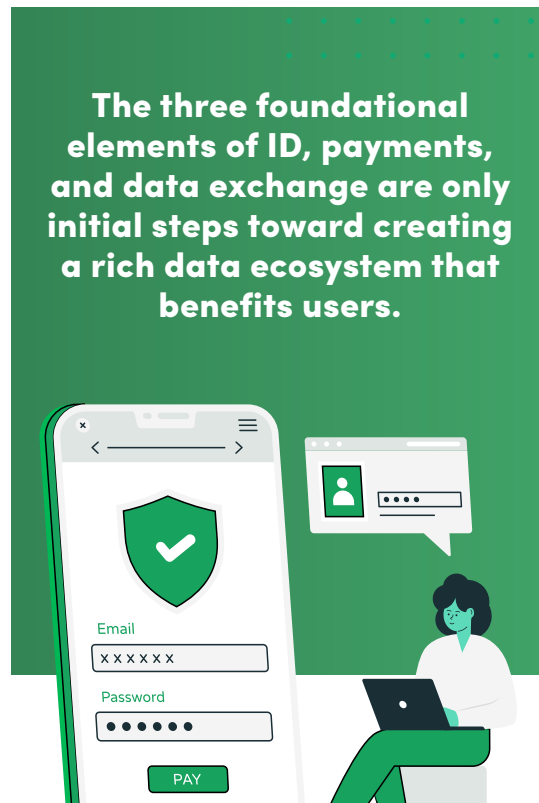
135   Open Digital Ecosystems. (n.d.).

136   Sharma, L., Natarajan, S., & Udhayakumar, K. (2021). Last Mile Access Study: Building offline architectures to enable better access to the state. Aapti Institute. https://uploads.strikinglycdn.com/files/294145ba-535f-4bcc-9579-6d4742d15509/Last%20Mile%20Report-Digital-Aapti%20Institute.pdf

notes: "Field studies have found that even when digital services are accessible, trusted intermediaries or community anchors play a critical role in enabling adoption. Therefore, such a 'phygital' [137] approach should be factored into the DPI vision. These intermediaries encompass a vast range of individuals and institutions, from local NGOs and community-based organizations to local politicians and trusted community leaders." [138]

3.2.2 Key Questions to Inform Responsible DPI for Financial Inclusion

The purpose of this report, written under the aegis of the Responsible Finance Forum, is to provide a landscape overview of what is known to date and to ask critical questions about where the sector should go from here. When considering how to implement a DPI system, it is important to consider the technology choices as well as to carefully account for any risks involved in introducing new public service systems, particularly regarding the impact on the system's users. Based on the evidence and discussions thus far, the inclusive finance sector should focus on the following questions to advance discussion and inform next steps on implementing responsible DPI for financial inclusion.

The three foundational elements of ID, payments, and data exchange are only initial steps toward creating a rich data ecosystem that benefits users.

→ **How do we embed governance from the beginning of any DPI initiative?**

Political benefits are not the only reason to engage the entire government in planning for DPI systems. Governance issues are best approached early on with as many stakeholders as possible to ensure alignment on key issues and concerns. As the UNDP noted in its recent evaluation report,[139] the ability of countries to scale their digital public infrastructure across different public service areas depends on the readiness

137   Kellton. (2020, February 14). Phygital Banking: A Robust Trust Model to be Reckoned With. https://www.kellton.com/kellton-tech-blog/phygital-banking-robust-trust-model
158   Kellton (2020)
159   United Nations Development Programme, Independent Evaluation Office. (2025, November). Evaluation of the UNDP Support to Digitalization of Public Services. https://erc.undp.org/evaluation/documents/download/25004

of the governance systems in addition to digital infrastructure. Are there ways that the private sector can help the public sector scale DPI systems without compromising public control? Questions of ownership, control, regulation, and oversight — not just of the rails but of the data itself — need to be openly addressed. It is also important to ensure that overengineering governance does not stifle the system for innovations and the ability to course correct as needed. While there is not necessarily one suitable approach that fits all countries, conversations should occur from the outset with input from multiple stakeholders in a transparent manner.

> → **How can we encourage innovation to build value while ensuring long-term sustainability and impact?**

The three foundational elements of ID, payments, and data exchange are only initial steps toward creating a rich data ecosystem that benefits users. For this to take place, we need to enable the ability to use data and develop relevant and affordable services that have sufficient mechanisms in place to protect consumers. Well-designed DPI can stimulate choice and competition. However, this requires participants working in the DPI systems to continually innovate to improve their services and offer greater value to end users. It also requires developing a framework of rules and regulations that allow markets to function competitively and help both public and private sector actors achieve their objectives.

Like all other infrastructure, DPI requires ongoing maintenance and upgrades so user data continues to remain secure, which requires careful consideration of ongoing investments, revenue generation mechanisms, and required financial resources. It is unlikely that most governments will be able to fully absorb these cost responsibilities on their own.

Because of this, public-private collaboration and shared infrastructure between countries offer possible pathways for consideration. Innovations like project FuSSE — launched in partnership by the Bank for International Settlements (BIS) and Inter-American Development Bank (IADB) — are good examples of shared infrastructure and should be followed closely to see how these partnerships play out and if they can offer a path for regional public infrastructure innovation.[140]

> → **How can citizen safeguards and protections be embedded into DPI, particularly in capacity-constrained environments or in environments with concerns?**

The phrase "user-centric DPI" is beginning to gain traction, and the first step in being user-centric is involving people in the insight generation and decision making process. This must

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140   Carstens, A. (2024, April 18). Project FuSSE: Closing technological gaps, while fostering growth and integration [Speech transcript]. BIS. https://www.bis.org/speeches/sp240418.htm

be accompanied by sufficient research on the successes and struggles of DPI adoption, and marginal gains beyond current systems. Is there merit in measuring citizen and user experiences and using that as a scorecard on implementation? Can countries have a legislative process in authorizing the introduction of DPI systems to ensure citizen rights are safeguarded? How do we ensure that non-technological aspects of DPI receive funding and get incorporated from the beginning, e.g., intra-government coordination and planning, citizen engagement, privacy and cybersecurity safeguards, and redressal mechanisms? Several lower-income countries struggle with resource and capacity constraints — from technical expertise to policy, regulatory, and institutional change management expertise. Digital capacity at local levels is particularly scarce. Striking an optimal balance between digital and non-digital dimensions (institutional and capacity elements) is crucial for sustainability and scaling.

→ **What are the industry metrics to assess the impact of DPI on consumer outcomes, particularly in the realm of financial inclusion and for the most vulnerable?**

As discussed earlier, while progress has been made in measuring increases in access to digital IDs and payments, most impact is still at the potential stage. Additionally, any impact analysis

should also aim to theorize and measure positive and negative externalities of DPIs — for instance, what happens when the state controls and has ownership of data? What does it mean for democracy, equality, and the market as a force for good? Accompanying these metrics should be a more rigorous tracking of progress. According to the UNDP, a lack of sufficient mechanisms at the country level to track actual adoption of eservices hindered digitalization efforts overall. We can learn from previous digitization efforts to ensure better outcomes with DPI.

→ **How do we capture best practices and amplify lessons learned?**

Few countries can tackle a broad-ranging DPI system that encompasses all aspects of the government. On-the-ground reality dictates that many countries begin incrementally with select apps and sectors, but how can early apps be future-proofed for inclusion into greater DPI systems? At the same time, we must acknowledge that certain elements of digital ecosystems are more crucial than others in speeding up digital transition, and countries with these digital capabilities have adapted faster. A primary accelerator was the efforts countries made to strengthen digital identity, digital financial services, and data interoperability.[141] What's the best way to leverage a regular exchange

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141   Cheney (2022)

between countries in the global South that are investing in DPI solutions and are at similar stages of development? And finally, how can we ensure that lessons learned, especially around community engagement and inclusion, governance, data protocols, cybersecurity, and redress are properly shared?
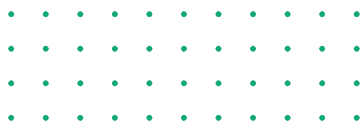
At the upcoming 2024 Responsible Finance Forum event in Fortaleza, Brazil, discussions on these open questions will inform the "Safeguards for Inclusive Digital Public Infrastructure" effort.

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