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Public Digital Infrastructure and Its Role in Driving Innovation in Digital Financial Services

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Abstract

Digital Public Infrastructure (DPI) has become a central facilitator of transformational innovation in digital financial services (DFS), especially in the emerging markets with a history of financial marginalisation and fragmentation of the markets. This paper critically analyzes the conceptual basis of DPI, the main elements, including the digital identity, interoperable payment system, and consent-based data exchange, and how DFS spurs innovation by reducing the costs, network effects, data-enabled credit evaluation, and collaboration between the government and the private sector. The analysis used a qualitative desk review approach with thematic synthesis of academic literature and policy reports and comparative case studies to investigate major implementations: the multi-layered India Stack (comprising of Aadhaar, Unified Payments Interface [UPI], and Account Aggregator]) in India and the Pix instant payment system in Brazil. Results show that DPI supports scaled rapidity, financial encompassment, economic formalization, and dynamism of the private sector, and UPI and Pix have recorded record volumes of transactions and fintech ecosystems. Nonetheless, the deployment has risks such as loss of privacy, cybersecurity risks, and digital exclusion, which require the implementation of sound governance structures. The paper is relevant to the literature on sustainable digital transformation as it not only points out the multiplier impacts of DPI in the Global South but also suggests new policy directions towards responsible, inclusive scaling. Such observations highlight why DPI can be a paradigm of a public good to shape technological progress with fair economic growth.

Keywords: Digital Public Infrastructure; Digital Financial Services; Financial Inclusion; Innovation Mechanisms; Interoperability; India Stack; Unified Payments Interface; Pix; Public-Private Collaboration; Global South

Introduction

The increased pace of digitalizing world economies has had gigantic transformations on the financial services landscape especially in developing economies where conventional banking networks have historically marginalized a large proportion of the population to the formal financial economy (Clark et al., 2025). Mobile payments, digital credit, insurance, and savings, a subset of digital financial services (DFS) has become essential to promoting financial inclusion, economic solidarity, and productivity. The scalability and innovational qualities of these services, however, are critically reliant on underlay digital systems that are secure, interoperable and available to societies. This is the place where the digital public infrastructure (DPI) comes to play a transformative role in its capacity to serve as shared open-platform

building blocks that allow both the public and private actors to provide equitable services at an efficient level (Hadda & Mukherjee, 2024).

DPI is understood as a family of common digital systems, which are created on the basis of open standards and technologies, aimed to provide fair access to both public and privatized services; to enhance inclusion, innovation, competition, and trust (Digital Cooperation Organization and Access Partnership, 2025). This definition has been formalized by the Group of Twenty (G20) which highlights the importance of security, interoperability, and governance models that promote human rights (as cited in Digital Cooperation Organization and Access Partnership, 2025). As a complement of this, United Nations Development Programme (UNDP) defines DPI as a changing structure of networked open technology standards with a public interest focus, to support competitive markets and innovative public programs. In its basic form, DPI consists of overlayed layers: digital identity systems, high-speed payment platforms, and consent-based data exchange operations, as superimposed on strong connectivity, and regulated by enabling regulations (Bill and Melinda Foundation, n.d.; Clark et al., 2025).

DFS is a driver of innovation in that DPI significantly decreases the transaction costs, barriers to onboarding and information asymmetries that historically limited the entry of the private-sector into underserved markets (Mukherjee and Arkalji, 2026). In contrast to proprietary or siloed digital platforms, which tend to reinforce monopolies and exclusion, DPI will take the form of an open architecture, requiring interoperability and low charges, thus establishing network effects and positive feedback loops to be adopted (Hadda & Mukherjee, 2024). This model of the public good will harmonize the incentive between governments that play a role in offering the rails and the innovators that will be involved in developing additional services on the rails. As a result, DPI transforms the institution-oriented models to the user-oriented ecosystems in which fintech entrepreneurs are able to fast prototype and scale the solutions to the last-mile populations (Center for Financial Inclusion, n.d.).

The effectiveness of DPI in stimulating DFS innovation is supported by empirical studies of the foremost implementations. The example of Unified Payments Interface (UPI), which is part of the wider India Stack alongside the Aadhaar (digital identity) and consent-driven data structures, is an example of this dynamic in India. Every UPI transaction allows billions of transactions each month, enabling interoperable payments between hundreds of banks and fintech applications, including embedded finance, micro-credit, and merchant digitization (Mukherjee & Arkalji, 2026). Likewise, the Pix central bank-led instant payment system in Brazil has been adopted by almost everyone since 2020 due to its mandatory nature, zero-cost person-to-person transfers, and open standards, such as ISO 20022, which have stimulated open finance innovation and start-up lending to small businesses (Digital Cooperation Organization and Access Partnership, 2025; Mukherjee and Arkalji, 2026). These examples demonstrate that DPI does not just increase access: that is, by making financial account ownership in developing economies more than 70 percent in recent years - but also produces granular transaction data opening up credit scoring to the unbanked and driving competitive service proliferation (Clark et al., 2025; Hadda and Mukherjee, 2024).

In theory, the innovation-driven processes at DPI flow in a variety of channels, which are interconnected. First, it will enable start-ups to create user experiences instead of reproducing the basic features of the most advanced products, speeding up commercialization because entry barriers are reduced through open APIs and shared infrastructure (Digital Cooperation Organization & Access Partnership, 2025). Second, interoperability brings about competition, which serves to prevent vendor lock-in and allows modular innovations, including offline payments or recurring mandates (Mukherjee & Arkalji, 2026). Third, data layers exchange with consent enable safe information flows, improve risk identification and customization

of credit and insurance products and maintain agency of the user (Center for Financial Inclusion, n.d.). All these factors have a multiplier effect on productivity as formal economy includes the advantage of a decrease in leakage in the public transfers, financial health and the spectrum of entrepreneurial action (Clark et al., 2025).

In spite of these developments, DPI does not have smooth sailing in DFS innovation. The risks in the issues of data privacy, cybersecurity, digital divides and governance trade-offs, especially in centralized identity systems, damage the trust and fair consequences without effective safeguards and inclusive design (Hadda and Mukherjee, 2024). Furthermore, although the examples of success in India and Brazil represent convincing models, their applicability to various institutional environments is not sufficiently studied, which requires more subtle considerations of the association between the public and the private and regulatory facilitators.

The paper will give an in depth analysis on the role of the public digital infrastructure in enhancing innovation in the digital financial services. It examines the processes, the results, and policy implications of DPI adoption based on conceptual approaches, comparative case studies (mainly India and Brazil) and empirical findings of global reports. The analysis will fill the current scholarly and policy research on sustainable digital transformation in the Global South by explicating how intelligently managed DPI can reconcile inclusion with transformative innovation.

Research Objectives

This research aims to critically analyze the scope of public digital infrastructure (DPI) in innovative development of digital financial services (DFS), with a specific reference to how an open, interoperable, and exclusively controlled digital infrastructure can empower scalable, user-friendly financial systems of emerging markets. Namely, the study will aim at achieving the following interconnected goals:

1. To represent DPI as an underlying framework of digital identity, payment systems, and consent-based layers of data exchange, and to define its key characteristics compared to proprietary digital platforms in fostering competition and inclusion (Digital Cooperation Organization & Access Partnership, 2025; Hadda and Mukherjee, 2024).
2. To explain how DPI can be used to foster innovation in DFS, such as cost reduction, network effects, data-enabled credit assessment, and public-private collaboration and to refer to theoretical ideas in platform economics and literature on innovation systems (Clark et al., 2025; Mukherjee and Arkalji, 2026).
3. To carry out comparative case studies of successful DPI implementations, especially the India Stack in India (comprising Aadhaar, Unified Payments Interface [UPI], and Account Aggregator]) and Brazil, Pix instant payment system, to find out contextual enablers, outcomes and lessons that can be transferred to DFS innovation (Mukherjee and Arkalji, 2026).
4. To evaluate the issues, risks, and governance requirements of DPI implementation in DFS including privacy concerns, cybersecurity risks, and digital exclusion, as well as to provide policy recommendations regarding responsible scaling (Hadda and Mukherjee, 2024; Center for Financial Inclusion, n.d.).
5. In order to build on academic and policy discussions about sustainable digital transformation by synthesizing evidence on the multiplier impacts of DPI on financial inclusion, economic formalization, and the dynamism of the private sector in the Global South (Bill & Melinda Gates Foundation, n.d.; Clark et al., 2025).

These goals are informed by the fact that DPI is a paradigm shift back to public-good-oriented digital architectures, and has far-reaching implications on the achievement of Sustainable Development Goals regarding financial inclusion (SDG 8 and 10) and innovation (SDG 9)..

Methodology

The current research follows a qualitative desk review methodology, which is an organized strategy of secondary research based on synthesis and critical evaluation of available scholarly literature, policy documents, technical report and empirical case study (Snyder, 2019). The use of desk review is especially appropriate to exploratory and interpretive research in emergent disciplines like digital public infrastructure, where primary data-gathering can be limited by the flux of technologies and policies, and the richness of secondary data offers the multi-stakeholder views (Adams et al., 2017). This approach allows strict triangulation of evidence with the logistical difficulty of fieldwork whilst preserving the scholarly richness of structured selection and analysis protocols.

Data Sources and Selection Criteria

The sources used to extract the data include peer-reviewed academic sources that were indexed on Scopus and Web of Science and grey literature in reputable international organizations and think tanks. Key sources included:

Reports by multilateral agencies (e.g. World Bank, United Nations Development Programme, G20-related documents);

Organization policy briefs and technical analysis of numerous organizations, including the Bill and Melinda Gates Foundation, Atlantic Council, Observer Research foundation America, and the Digital Cooperation Organization;

Documentation about India Stack including central bank publications and evaluative studies on the India Stack.

Search methods used Boolean operators within databases (e.g.,digital public infrastructure" AND (financial inclusion" OR digital payments" OR fintech innovation)) between 2018-2026, but focused on sources published after 2020 to find the latest developments in DPI. Inclusion criteria were sources that needed to offer empirical rigor, policy relevance, or conceptual development, exclusion criteria included non-English and opinion pieces with no evidence and publications before 2018 that were not relevant in the contemporary context. More than 50 documents were reviewed, 15-20 core references were used to create the basis of analysis.

Analytical Approach

Thematic synthesis and comparative case study were used to analyze the data in an iterative manner (Yin, 2018). Primary coding determined common themes, including but not limited to interoperability, model governance, mechanism of innovation and risk factors based on deductive categories of platform theory as well as inductive information of the literature. A comparative study was conducted to compare the layered DPI stack with an identity-centric approach in India with the payment-centric system of Pix in Brazil to emphasize the contextual differences in institutional design, adoption dynamics, and innovation outcomes (Mukherjee and Arkalji, 2026). Critical interpretation implicitly tackled possible biases in source materials (e.g. promotional discourses in institutional reports) by cross-verifying and representing issues and achievements equally.

This desk review methodology is both transparent, reproducible, and scholarly strong and offers subtle, evidence-based results on the transformative potential of DPI in DFS.

Conceptualizing Digital Public Infrastructure

The Digital Public Infrastructure (DPI) conceptualization is an important shift in the way we think about digital transformation, where individual, application-specific technologies are replaced by shared, population-scale systems that act as civil society enablers of the scale of other common social amenities such as roads, electricity grids or telecommunication networks (Clark et al., 2025; Marskell et al., 2025). DPI, initially proposed in policy and development circles since as early as the early 2020s, has gained momentum due to the exposure of physical vulnerabilities to digital infrastructure (e.g. broadband connectivity and data centres) by the COVID-19 pandemic and is understood as an intermediate in the digital ecosystem, connecting the physical infrastructure (e.g. broadband connectivity and data centres) and the sectoral application (e.g. e-commerce, social protection, or telehealth) (Marskell et al., 2025).

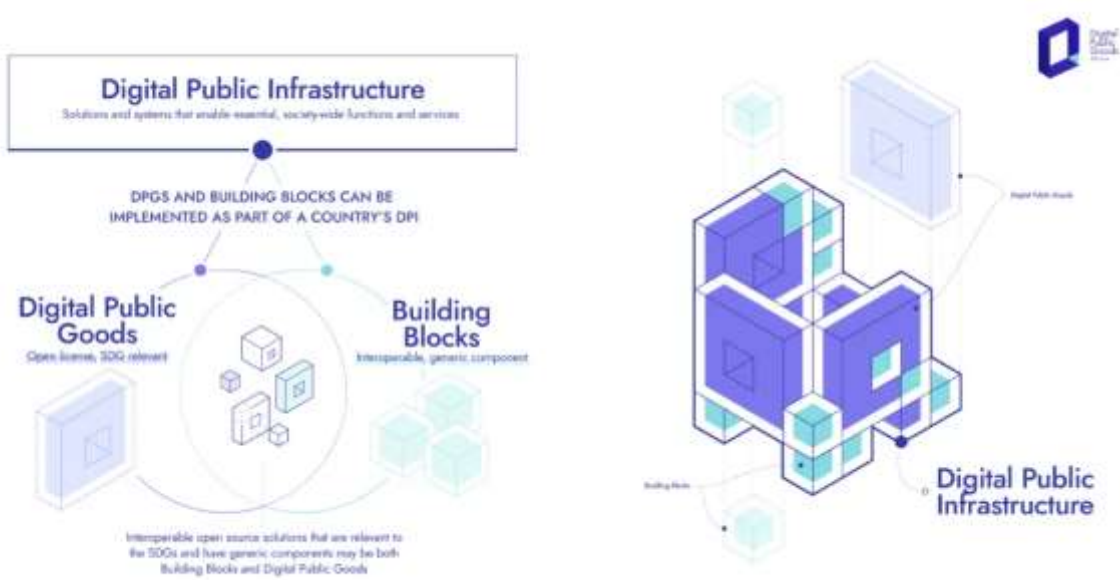

Figure 1: Layered architecture of DPI, showing connectivity as the base and reusable building blocks forming the foundational layer for digital public goods.
(Source: GovStack, 2022)

Administrative definitions highlight the public-good orientation and technicality of DPI. According to the World Bank, DPI comprises of basic capabilities, including identification, payments, and data sharing capabilities, which are building blocks of transformative digital services at a societal level (Marskell et al., 2025, p. 67). Equally, the United Nations Development Programme (UNDP) defines it as a collection of underlying digital platforms that constitute the core of the contemporary societies, allowing safe and smooth exchanges between individuals, businesses, and governments (United Nations Development Programme, n.d.). This is tightened in the G20 consensus of a set of common digital systems which should be secure and interoperable, based on open standards and specifications... to access and deliver equitable access to both public and/or private services at societal scale and respect human rights (G20, 2023, as cited in Clark et al., 2025).

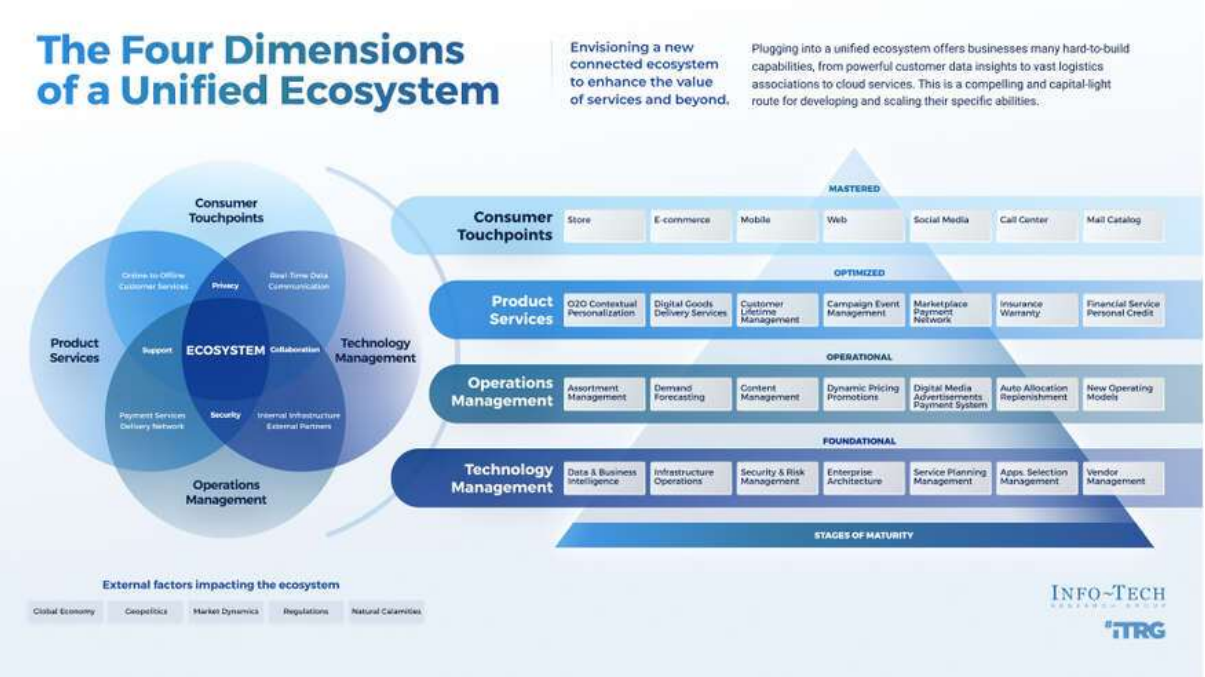

Figure 2: DPI building blocks and their relationship to digital public goods, emphasizing interoperability and open-source components.
(Source: Digital Public Goods Alliance / GovStack)

A more normative conceptualization comes from Co-Develop (2025), which posits DPI as "society-wide, digital capabilities that are essential to participation in society and markets as a citizen, entrepreneur, and consumer in a digital era." This view emphasizes four core principles that distinguish DPI from proprietary platforms:

1. **Inclusive** — Near-universal access, minimizing exclusion (e.g., ensuring marginalized groups can verify identity for benefits).
2. **Foundational** — Extensible by any actor, allowing public and private entities to build atop it without duplication.
3. **Interoperable** — Based on open standards to enable competition and seamless integration.
4. **Publicly accountable** — Governed through multi-stakeholder mechanisms involving government, civil society, and private sectors to safeguard public interest.

These principles address risks of monopolization inherent in closed systems, positioning DPI as a counterbalance to platform capitalism (Co-Develop, 2025).

Conceptually, DPI is often visualized through layered architectures, as exemplified by India's "India Stack," which integrates identity (Aadhaar), payments (Unified Payments Interface), and data empowerment layers. Broader frameworks depict DPI as modular building blocks—digital public goods and interoperable components—that collectively form resilient ecosystems.

Figure 3: Five foundational DPI categories within and across sectors (Identities & Registries, Payments, Data Sharing & Credentials, Trust Infra, Discovery & Fulfillment).
(Source: Centre for Digital Public Infrastructure [CDPI], 2023)

Core components recurrently identified include:

- **Digital identity systems** → For verifiable authentication and access (e.g., foundational or functional IDs).
- **Digital payment infrastructures** → For fast, low-cost, interoperable transactions.
- **Consent-based data exchange platforms** → For secure, user-controlled information sharing (Marskell et al., 2025; Co-Develop, 2025).

Emerging elements encompass e-signatures, open APIs, and sector-specific extensions (e.g., health or education registries). Theoretically, DPI draws from public goods economics, where non-rivalrous and non-excludable characteristics justify public investment and governance to mitigate market failures (Clark et al., 2025). It also aligns with platform theory, creating network effects that amplify value through multi-sided interactions while mandating safeguards against enclosure.

In essence, DPI reorients digital development toward inclusive, rights-respecting systems that prioritize societal impact over proprietary control, providing a robust foundation for innovation in domains such as digital financial services (Co-Develop, 2025; Marskell et al., 2025).

Mechanisms Through Which DPI Drives Innovation in Digital Financial Services

Digital Public Infrastructure (DPI) enhances innovation in digital financial services (DFS) through open and interoperable foundational layers to help curb market failures that occur in proprietary digital ecosystems. To borrow the platform economics literature--especially multi-sided platforms theory and network externalities theory (Rochet and Tirole, 2003; Parker et al., 2016) and the innovation systems literature focusing on open and collaborative architecture (Chesbrough, 2003; Lundvall, 1992) DPI can be viewed as a common asset that coordinates public with a private source of ingenuity. This part explains 4 synergetic processes namely cost reduction, network effects, data-enabled credit assessment and public-

private collaboration, how these processes turn DFS into dynamic, inclusive markets out of fragmented, high-friction systems.

Cost Reduction

DPI dramatically reduces entry barriers as well as costs to operate and can allow fintech innovators to experiment and scale quickly. Shared infrastructure also removes the need to have private bodies reproduce core capabilities, like identity verification or payment rails, and instead focus on value-added services. In India, Aadhaar-Unified Payments Interface (UPI) integration dropped the know-your-customer (KYC) costs down to an estimated between US23 and US$0.15 a customer onboarding, with fast payment systems (FPS) such as UPI and Brazil's Pix minimizing transaction costs using deferred net settlement and standardized messaging (i.e. ISO 20022) (Clark et al., 2025; Mukherjee and Arkalji, 2026). This cost-effectiveness can be seen through a near-zero charge to person-to-person transfers, which promotes competition among banks, fintechs, and non-bank providers and leads to the innovations in merchant payment, e-wallets and embedded finance (Hadda and Mukherjee, 2024). In theory, this compares with platform economics, which focuses on subsidizing one market side (e.g. users) to encourage participation, which lowers the coordination costs and spurred commercialization in low-served markets.

Network Effects

DPI creates strong network externalities that are both direct and indirect with value of system growing exponentially by adoption, creating positive feedback loops that enhance innovation. Interoperability requirements, including mandatory Pix use at larger organizations or the open APIs of the UPI, are a guarantee of smooth connectivity among providers, which quickly increases use and utility (Mukherjee and Arkalji, 2026). With the increasing number of users and merchants involved, such hubs as UPI (processing more than 46 percent of real-time transaction volume in the world) and Pix are becoming a matter of fact, reducing switching costs and avoiding silos (Hadda & Mukherjee, 2024). In the platform economics view, DPI alleviates the chicken-and-egg issues of two-sided markets by offering neutral rails, which appeal to both demand (consumers) and supply (service providers), and generate multiplier effects on innovation, including overlay services to recurring payments or cross-border links (Carnegie Endowment for International Peace, 2024; Clark et al., 2025). This is reflective of national innovation systems theory where a system of shared infrastructures can create systemic interaction and knowledge spillovers to turn passive adoption into active ecosystem co-evolution.

Data-Enabled Credit Assessment

Data exchange layers on DPI that are based on consent provide access to granular real-time financial histories, which are used to bridge the asymmetry of information pools that have traditionally left unbanked individuals out of credit markets. Models such as the Data Empowerment and Protection Architecture (DEPA) of India and Account Aggregator provide an opportunity to share transaction data with third parties safely and controlled by the user to allow the development of advanced credit scorecards and personalized lending (Clark et al., 2025; Mukherjee and Arkalji, 2026). Volume transactions on UPI and Pix produce enriched data that can be used to model alternative credit arrangements to micro, small and medium-sized enterprises (MSMEs) and informal workers and spread access along with minimizing default risks related to fraud and real-time analytics (Hadda and Mukherjee, 2024). Theoretically, this

mechanism represents the principles of open innovation, in which DPI represents a boundary-spanning resource that disseminates information as a public good, and private actors are allowed to recombine it to new products (i.e. embedded insurance or supply-chain finance) without proprietary protection (Chesbrough, 2003).

Public-Private Collaboration

The governance model of DPI encourages symbiotic relationships where governments offer minimalist and regulated pillars and the private sectors create on the pillars. Organizations such as the National Payments Corporation of India (NPCI) a non-profit entity owned by banks and the central bank or Pix a central bank initiative in Brazil are examples of multi-stakeholder regulation, which provides interoperability, trust, and accountability (Mukherjee and Arkalji, 2026). In this partnership, the private investment in overlay innovations (e.g., third-party apps on UPI) is mobilised whilst the public protection against crowding out or monopolisation (Carnegie Endowment for International Peace, 2024; Clark et al., 2025). These hybrid models are found in innovation systems literature to promote interactive learning and institutional compatibility to put DFS on the path of user-oriented ecosystems balancing between inclusion and competitive dynamism (Lundvall, 1992).

These processes are synergistic: scale is generated by cost savings and network effects, creating credit innovation input, and looped by collaborative governance. The results in India and Brazil show that DPI can bypass legacy systems, as is consistent with the focus on governance of positive externalities in platform economics, and the frameworks of inclusive and adaptive innovation systems in platform economics.

Comparative Case Analyses of Leading DPI Implementations: India's India Stack and Brazil's Pix

This study conducts comparative case analyses of two pioneering DPI implementations in digital financial services (DFS): India's **India Stack**—a multi-layered ecosystem encompassing Aadhaar (digital identity), Unified Payments Interface (UPI), and Account Aggregator (consent-based data sharing)—and Brazil's **Pix**, a centralized instant payment system launched by the Central Bank of Brazil (Banco Central do Brasil, BCB). These cases were selected for their global leadership in real-time payments, achieving the highest transaction volumes worldwide, and their explicit DPI characteristics of interoperability, inclusivity, and public governance (Mukherjee & Arkalji, 2026; Co-Develop Digital Public Infrastructure, 2024; Bank for International Settlements, 2024a). Through contextual examination of enablers, outcomes, and comparative insights, this analysis identifies transferable lessons for DFS innovation in emerging economies.

India's India Stack

India's DPI evolved as a layered, modular architecture known as the India Stack, designed to address pervasive financial exclusion in a population with historically low banking penetration and a large informal economy (Clark et al., 2025; Mukherjee & Arkalji, 2026).

Contextual enablers included the government's Jan Dhan-Aadhaar-Mobile (JAM) trinity, which linked bank accounts to biometric identity (Aadhaar, covering >1.3 billion individuals) and mobile connectivity, alongside governance by the non-profit National Payments Corporation of India (NPCI), a bank-led consortium under Reserve Bank of India oversight (Hadda & Mukherjee, 2024; Patnam et al., 2024). Open APIs and zero merchant discount rates for UPI further stimulated private-sector participation.

Outcomes have been transformative: UPI processed over 13 billion monthly transactions by 2024, representing ~46% of global real-time payments, with widespread fintech innovation in embedded lending, insurance, and merchant QR codes (Mukherjee & Arkalji, 2026; Bank for International Settlements, 2024b).

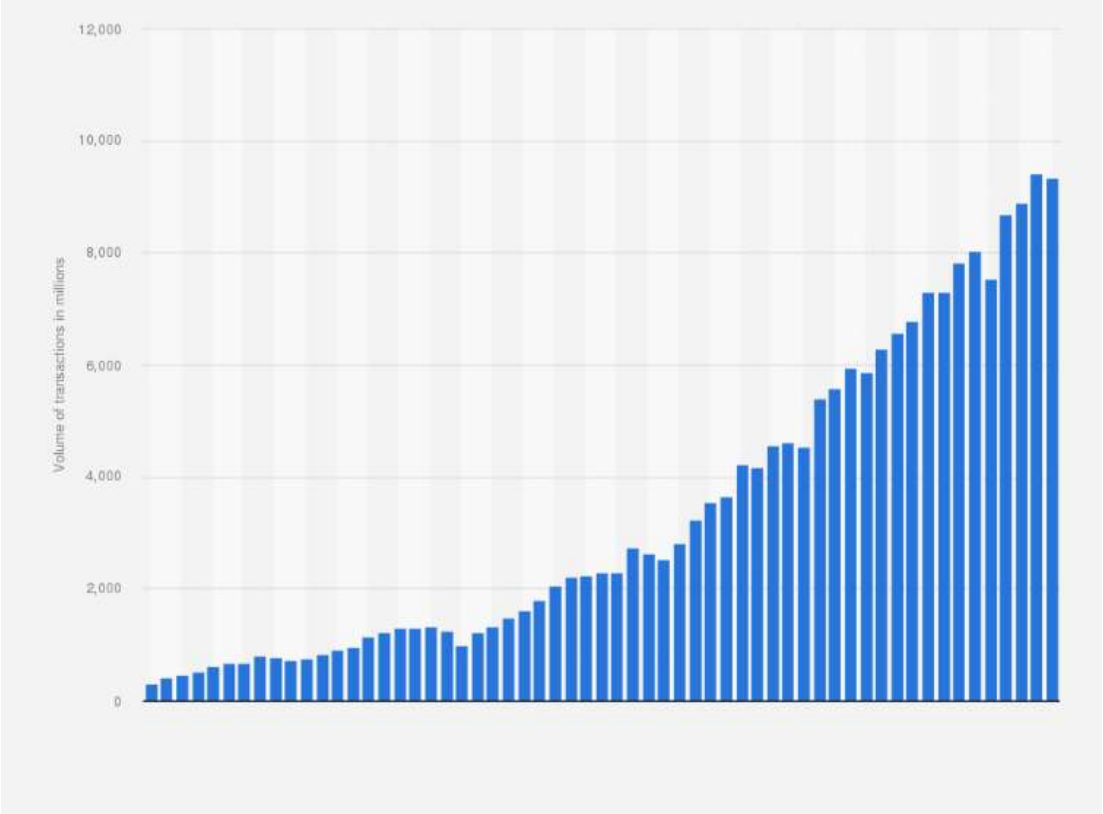

Figure 4: Monthly Transaction Volume on India's Unified Payments Interface (UPI), 2016–2024 (in millions of transactions)

Source: National Payments Corporation of India (NPCI), compiled from official monthly product statistics (accessed February 2026). Available at: https://www.npci.org.in/what-we-do/upi/product-statistics.

The Account Aggregator framework has enabled consent-based data flows, boosting credit access for unbanked segments and MSMEs through alternative scoring (Co-Develop Digital Public Infrastructure, 2024; Atlantic Council, 2024).

Brazil's Pix

In contrast, Brazil's Pix represents a focused, payments-centric DPI, launched in November 2020 as a central bank-led instant payment platform overlaid on existing banking infrastructure (Mukherjee & Arkalji, 2026; Barroso & Melo, 2023).

Contextual enablers encompassed BCB's direct authority, mandatory participation for large institutions, free person-to-person (P2P) transfers, and adoption of ISO 20022 standards for interoperability. The COVID-19 pandemic accelerated uptake by necessitating contactless transactions in a relatively banked population (~85% adult account ownership pre-Pix) (Patnam et al., 2024; Bank for International Settlements, 2024a).

Outcomes include rapid scale-up to billions of monthly transactions, with Pix capturing ~90% of digital payments by volume and formalizing informal transactions, particularly among small businesses (Mukherjee & Arkalji, 2026; EBANX, 2025).

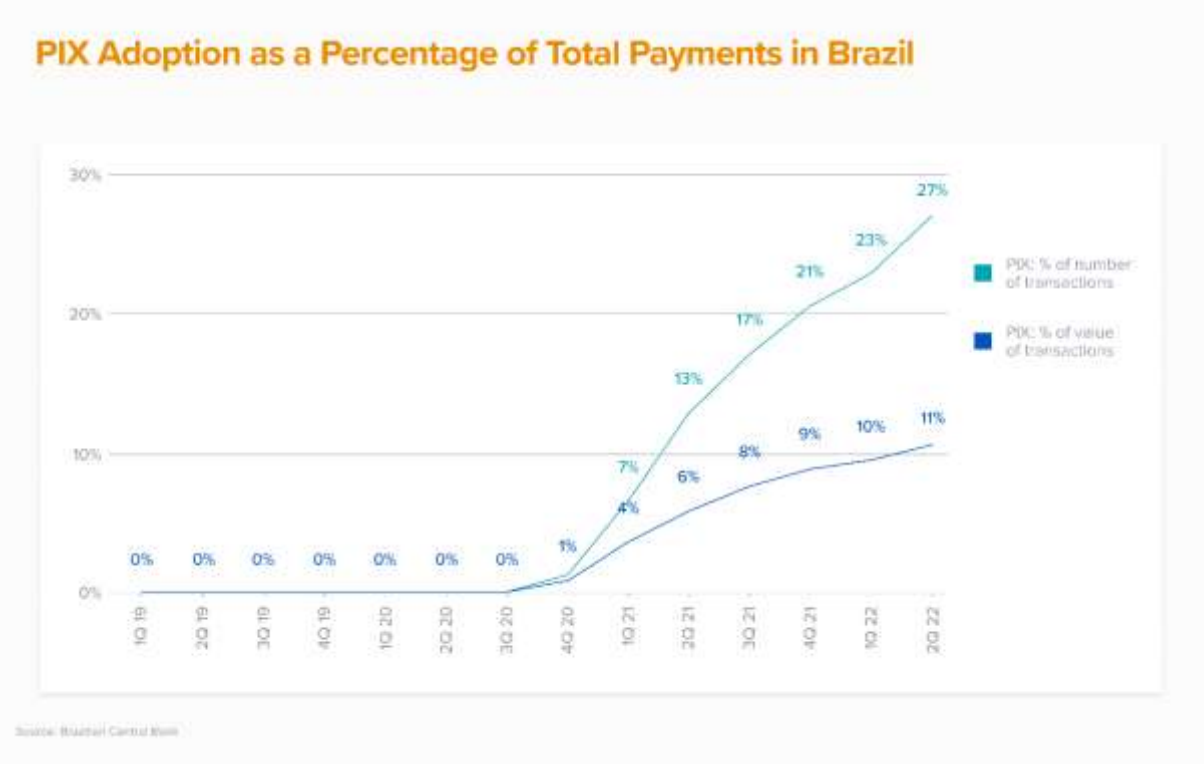

Figure 5: Pix Adoption as a Percentage of Total Payment Transactions in Brazil, by Number of Transactions and Value, Fourth Quarter 2020–Fourth Quarter 2022

Source: Banco Central do Brasil (Brazilian Central Bank), as presented in official Pix statistics and reports.

It has laid foundations for open finance extensions while reducing reliance on cash and cards (Co-Develop Digital Public Infrastructure, 2024; Consultative Group to Assist the Poor, 2021).

Comparative Insights and Transferable Lessons

Both systems share core DPI attributes—interoperability, low/zero costs for users, 24/7 availability, and public governance—driving network effects and inclusion (Mukherjee & Arkalji, 2026; FXC Intelligence, 2024; Patnam et al., 2024). Similarities in rapid adoption (Pix reaching 80% adult penetration faster than UPI) underscore the efficacy of mandatory elements and inclusive pricing (Payments CMI, 2023; Co-Develop Digital Public Infrastructure, 2024).

Key differences highlight contextual adaptation: India's layered approach integrates identity and data sharing to tackle deep exclusion in an informal economy, fostering diversified fintech overlays (e.g., credit via Account Aggregator), while Brazil's streamlined payments focus leverages pre-existing banking density for quicker transactional formalization (Barroso & Melo, 2023; Atlantic Council, 2024; Global Journal of Engineering and Technology Advances, 2025). Governance models differ—consortium-based (NPCI) versus central bank-direct (BCB)—with India's enabling greater private innovation but requiring stronger coordination (Hadda & Mukherjee, 2024; Center for Global Development, 2025).

Transferable lessons for DFS innovation include:

1. **Institutional leadership and mandate** — Strong public oversight with mandatory interoperability accelerates scale (Mukherjee & Arkalji, 2026; Bank for International Settlements, 2024a).
2. **Open standards and minimalism** — Focus on core rails (payments) with extensibility allows private-sector differentiation (Co-Develop Digital Public Infrastructure, 2024; Consultative Group to Assist the Poor, 2021).
3. **Context-sensitive layering** — Identity and data components enhance inclusion in low-banked settings, while payments-alone suffice in higher-banked contexts (Clark et al., 2025; Patnam et al., 2024).
4. **Incentive alignment** — Zero fees for P2P/P2B and subsidized onboarding drive network effects and equity (FXC Intelligence, 2024; EBANX, 2025).

These cases affirm DPI's role in catalyzing user-centric DFS ecosystems, offering replicable blueprints tempered by local institutional and socioeconomic realities (World Bank, 2025; South Centre, 2025).

Challenges, Risks, and Governance Imperatives Associated with DPI Deployment in Digital Financial Services

While Digital Public Infrastructure (DPI) has driven transformative innovation in digital financial services (DFS), its population-scale deployment introduces significant challenges and risks that could undermine inclusion, trust, and sustainability if unaddressed. These encompass privacy concerns, cybersecurity vulnerabilities, digital exclusion, and broader structural issues such as surveillance potential, institutional weaknesses, and unsustainable financing (Digital Cooperation Organization, 2025; Universal DPI Safeguards Initiative, n.d.). In DFS contexts—where sensitive financial data flows through identity, payment, and data-sharing layers—these risks are amplified, potentially exacerbating inequalities or enabling misuse. This section assesses these challenges, delineates governance imperatives, and proposes policy recommendations for responsible scaling, drawing on rights-based frameworks and empirical insights from implementations like India's India Stack and Brazil's Pix.

Privacy Concerns

DPI's reliance on centralized or interoperable data architectures heightens privacy risks, particularly in DFS where transaction histories and identity details enable granular profiling. Extensive personal data collection can lead to identity theft, unauthorized surveillance, or commercial exploitation without robust consent mechanisms (Digital Cooperation Organization, 2025). In India, Aadhaar-linked systems have faced criticism for potential function creep and data linkages that erode privacy, despite the Supreme Court's 2018 restrictions on private-sector mandatory use (Center for Financial Inclusion, 2025). Consent-based frameworks like India's Account Aggregator mitigate some risks through data minimization and user control, yet implementation gaps—such as inadequate observability or overreaching data requests—persist (Universal DPI Safeguards Initiative, n.d.). Privacy-by-design principles, including delinking identifiers and lawful processing limits, are essential to prevent breaches that erode trust in DFS ecosystems.

Cybersecurity Vulnerabilities

Population-scale DPI creates high-value targets for cyber threats, with single points of failure risking widespread disruption in financial services. Vulnerabilities arise from technical shortcomings, outdated

infrastructure, or insufficient encryption, exposing payment systems like UPI or Pix to attacks, fraud, or data breaches (Digital Cooperation Organization, 2025). Real-world incidents, such as phishing exploits in fast payment systems, highlight the need for ongoing monitoring and resilience measures (Center for Financial Inclusion, 2025). Security-by-design—incorporating encryption, pseudonymization, and regular audits—forms a critical safeguard, complemented by legal frameworks mandating rapid incident response (Universal DPI Safeguards Initiative, n.d.). In DFS, where real-time transactions dominate, cybersecurity lapses can cascade into economic losses and diminished adoption among vulnerable users.

Digital Exclusion

Despite inclusion goals, DPI risks exacerbating digital divides by favoring those with connectivity, devices, and literacy. Marginalized groups—rural populations, elderly, low-income, or disabled individuals—may face unequal access, discrimination in algorithmic processes, or mandatory digital channeling that excludes non-digital alternatives (Digital Cooperation Organization, 2025; Universal DPI Safeguards Initiative, n.d.). In emerging markets, connectivity gaps (e.g., 59% unconnected despite coverage in parts of Africa) compound this, limiting DFS benefits like mobile payments or credit access (Digital Cooperation Organization, 2025). India's JAM trinity advanced inclusion but unevenly, with gender and ability barriers persisting; Brazil's Pix achieved broader uptake in a more banked context but still encounters accessibility issues for informal workers (Center for Financial Inclusion, 2025). Principles of non-discrimination, non-exclusion, and community-centered design are imperative to ensure equitable outcomes.

Governance Imperatives and Broader Risks

Effective governance must balance innovation with accountability, addressing risks like weak rule of law, vendor lock-in, distrust from overreach, and unsustainability (Universal DPI Safeguards Initiative, n.d.). Multi-stakeholder models—incorporating governments, private sector, civil society, and users—promote transparency, participatory oversight, and redress mechanisms. Imperatives include embedding human rights-based approaches (do no harm, autonomy), evidence-based evolution through audits, and inclusive governance to prevent monopolization or impunity (Digital Cooperation Organization, 2025; Universal DPI Safeguards Initiative, n.d.). In DFS, hybrid models (e.g., India's NPCI consortium) illustrate successes but require safeguards against power imbalances.

Policy Recommendations for Responsible Scaling

To mitigate risks and enable responsible DPI scaling in DFS, policymakers should adopt the following evidence-informed recommendations:

1. **Embed Rights-Based Safeguards** — Integrate foundational principles (e.g., do no harm, non-exclusion) and operational measures (privacy/security by design, data minimization) across DPI life cycles, using frameworks like the Universal DPI Safeguards for self-assessments and action plans (Universal DPI Safeguards Initiative, n.d.).
2. **Strengthen Regulatory Frameworks** — Enact comprehensive data protection laws, mandatory interoperability standards, and oversight for cyber resilience, while funding connectivity and literacy programs to bridge divides (Digital Cooperation Organization, 2025).
3. **Foster Multi-Stakeholder Collaboration** — Establish transparent governance bodies with civil society input, diversified financing (public-private partnerships), and open assets to avoid proprietary

lock-in and ensure sustainability (Digital Cooperation Organization, 2025).

4. **Prioritize Inclusive and Evidence-Based Design** — Mandate alternative access channels, community engagement for at-risk groups, independent audits, and effective remedy mechanisms to build trust and adapt to emerging risks (Universal DPI Safeguards Initiative, n.d.).
5. **Contextual Adaptation** — Tailor approaches to local institutional capacities, avoiding one-size-fits-all models, and invest in capacity-building for regulators and users in DFS ecosystems (Center for Financial Inclusion, 2025).

These measures, if implemented iteratively, can transform DPI risks into opportunities for resilient, equitable DFS innovation.

Conclusion

This paper aimed to contribute to current scholarly and policy debates on the way in which nations in the Global South can realize sustainable digital developments. Drawing together the evidence of real-world examples, primarily those of India and Brazil that is India Stack and Pix, one can observe that Digital Public Infrastructure (DPI) generates strong multiplier effects. Such impacts are not confined to improved financial services, they extend to financial inclusion, economic formalization and energy in the private sector which serve the wider objective of sustainable development.

To start with, DPI has evidently increased financial inclusion. The Aadhaar (digital ID), bank account under Jan Dhan and UPI payments in India gave access to formal finance dramatically. Prior to the existence of such systems, a large section of the population, particularly in rural regions, as well as women, did not have bank accounts. Today, the percentage of adult accounts has soared to more than 80 percent and hundreds of millions of people utilize the digital payment on a regular basis (Clark et al., 2025). Pix allowed making instant payments at no cost and without difficulty in Brazil, within a few months it became accessible to even the lower portion of the population and bumped up the use of accounts (Mukherjee & Arkalji, 2026). Research indicates that as individuals become able to access digital credit and savings via such mechanisms, household welfare also rises - people save more, borrow judiciously, and cushion themselves against shocks (Patnam et al., 2024). The multiplier in this case is obvious, a common infrastructure will open opportunities to millions of people who were excluded.

Second, DPI assists in formalizing economies. The Global South is based on cash and informal transactions, and this makes it difficult to pay taxes, trace growth, or even social support. UPI and Pix have transferred enormous amounts of transactions into electronic records. Small merchants in India also accept payments in the form of QR code, which introduces the informal sales to the formal system and enhances their access to credit (Hadda & Mukherjee, 2024). In Brazil, Pix decreased the cash utilization and assisted millions of micro-businesses in getting registered, which allowed the company to enhance the collection of taxes and the provision of more precise economic information (Barroso & Melo, 2023). It has been estimated that this formalization contributes to GDP growth by decreasing leakage in government transfer and promoting business registration (Clark et al., 2025). The spill over effect enhances individual finances and a more transparent economy is born.

Third, DPI instigates dynamism in the private sector. DPI allows firms and companies to innovate by giving them open and reliable building blocks, which they do not need to build anything themselves. UPI open APIs have caused a fintech boom in India: there are numerous apps such as PhonePe, Google Pay, and others to lend money, provide insurance, and invest over payments. This has provided employment to thousands of people and new business models (Mukherjee & Arkalji, 2026). The Pix in Brazil also created

the opportunity of the new payment providers and embedded finance solutions. The outcome is that it makes competition quicker, decreases consumer costs, and generates more inventive services to underserved markets (Co-Develop Digital Public Infrastructure, 2024). This is industry energy which promotes productivity and entrepreneurship which are essential constituents of sustainable growth.

Collectively, the mentioned multiplier effects demonstrate that DPI is not a mere technical instrument, but a pillar to equitable digital transformation. DPI can ensure Global South countries jump over the old hurdles and establish strong economies when it is designed with inclusion, interoperability and good governance. Nevertheless, it will only be successful in case risks such as privacy gap and digital divide are tackled as it was mentioned above.

The practical implications of the lessons to researchers and policymakers include: invest in common infrastructure, give more focus on open standards, and consider the participation of different stakeholders in the early stages. This is why countries that think about DPI should not think about India and Brazil as ideal examples, but as evidence that intelligent leadership by the people can open the door to individual innovation and social benefits. In order to make these approaches more refined, future work must monitor the long-term effects of these approaches on inequality, job creation, and environmental sustainability.

In brief, DPI provides a bright future with inclusive, formal, and dynamic digital economies. Through such experiences, the Global South will be able to develop a digital future that will be actually beneficial to everyone.

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