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The Interdisciplinary Play of Economy and Technology: Quantifying India Stack's Role in Reducing Fiscal Leakage and Bridging the Rural-Urban Digital Divide

Rahul Ratan Kushwaha,
Assistant Professor, Department of Management Studies,
KES' Shroff College of Arts and Commerce (Affiliated to Mumbai University), Kandivali West, Mumbai 400067

Abstract

The integration of Digital Public Infrastructure (DPI) has fundamentally reshaped India's socio-economic landscape, marking a transition from rudimentary digitisation to a sophisticated ecosystem of "Intelligent Delivery." This research paper provides an interdisciplinary analysis of the "India Stack", comprising identity (Aadhaar), payments (UPI, AePS), and data exchange (DigiLocker, Account Aggregator) layers, during its critical maturation phase from 2021 to 2026. The primary goal of this study is to quantify the "Digital Dividend" reaped by the Indian state and its citizens across four dimensions: economy, technology, management, and social inclusion. Specifically, the study evaluates the impact of Direct Benefit Transfer (DBT) on fiscal efficiency, finding that cumulative savings crossed ₹3.48 lakh crore by March 2024 through the elimination of duplicate and ghost beneficiaries. To assess financial inclusion, the research analyses the penetration of digital payment systems, noting a rise in the RBI Financial Inclusion Index to 67.0 in 2025 and a surge in UPI transactions to 185.8 billion annually. Furthermore, it investigates administrative cost reductions, documenting a 95% collapse in KYC expenses and an 80% drop in loan origination costs via the Unified Lending Interface (ULI). Utilising a mixed-methods approach, the study synthesises administrative datasets with econometric tools, including the Welfare Efficiency Index (WEI), which rose from 0.32 in 2014 to 0.91 in 2023. The findings reveal a "multi-speed" digital economy where urban hubs like Delhi lead in transaction intensity, while rural "Bharat" relies on Aadhaar-enabled Payment Systems (AePS) as a vital lifeline. The paper concludes that by 2026, the institutionalisation of the Digital Personal Data Protection (DPDP) Act and AI-driven "Invisible Governance" have secured a "Privacy-by-Design" framework, positioning India as a global template for equitable digital growth.

a. Introduction

The conceptualisation of "Digital India" in 2015 marked a paradigm shift in Indian governance, moving from a manual, intermediary-heavy system to a tech-first approach. At the heart of this transformation lies the "India Stack", a modular collection of open APIs and digital public goods designed to solve population-scale problems. This infrastructure operates through three interconnected layers: the Identity Layer (Aadhaar), which provides unique biometric IDs to 1.4 billion residents; the Payment Layer (UPI, AePS), which facilitates seamless financial transfers; and the Data Layer (DigiLocker, Account Aggregators), which enables consent-based data sharing. By 2026, this infrastructure will have transitioned into a phase of "Intelligent Delivery," where governance is no longer just about digitising records but about leveraging Artificial Intelligence (AI) and the Digital Personal Data Protection (DPDP) Act to create a "Privacy-by-Design" framework.

This study explores the interdisciplinary play of economy, technology, and management in architecting what is now termed "Invisible Governance." In this model, the state proactively delivers subsidies and services directly to the intended recipients without a single physical touchpoint. The first major dimension of this evolution is fiscal efficiency. Through the Direct Benefit Transfer (DBT) mechanism, India has re-engineered its welfare delivery, reaching 176

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crore beneficiaries—a 16-fold expansion since 2013. By March 2024, the government achieved cumulative savings of ₹3.48 lakh crore, primarily by purging system leakages, including 5.87 crore fake ration cards and 4.23 crore duplicate LPG connections. This fiscal optimisation is reflected in the Welfare Efficiency Index (WEI), which indicates that digital rails have allowed for higher coverage even as proportional subsidy expenditure halved from 16% to 9% of total expenditure.

The second dimension is the democratisation of financial inclusion. While India achieved 89% account ownership in a single decade, a feat that typically takes 50 years, the 2021–2026 period has focused on deepening "Usage" and "Quality". UPI transaction volumes surged from 1 billion in 2018 to over 185 billion in FY 2025, handling values equivalent to 58% of monthly household consumption. However, a significant digital divide persists; states like Delhi record 23.9 monthly UPI transactions per person, while rural regions like Bihar average fewer than four, highlighting a multi-speed adoption curve.

Thirdly, the research analyses the administrative lifecycle synergy of the stack. The transition to Aadhaar-based e-KYC has reduced bank onboarding costs from approximately ₹1,000 to less than ₹6, a 95% reduction. The 2024 launch of the Unified Lending Interface (ULI) further simplified credit management, reducing per-loan origination costs by 80% and shortening turnaround times from weeks to minutes. As of 2026, the ecosystem has matured with AI missions and the DPDP Act 2023, transforming data privacy from a compliance hurdle into a strategic differentiator and brand promise for the nation's digital future.

b. Review of Literature

The contemporary academic discourse on India’s Digital Public Infrastructure (DPI) conceptualizes the "India Stack" as a transformative "synergistic triad" of policy, identity, and technology that functions as the "national plumbing" for the Internet Age. Khanna, Raina, and Chawla (2023) argue that this architecture has allowed India to "leapfrog" traditional developmental processes, shifting the nation from an offline, cash-heavy, low-productivity economy to an online, formal, high-productivity ecosystem in less than a decade. This model is characterized in literature as a "Digital Democracy" where public digital rails enable private-sector innovation to flourish, democratizing access to the internet and financial services for over 1.4 billion people.

Regarding fiscal efficiency, scholarly evaluations of the Direct Benefit Transfer (DBT) mechanism emphasize its role in re-engineering public welfare management. Bhat (2025) introduces the "Welfare Efficiency Index" (WEI) as a robust tool to quantify systemic gains, empirically validating that digital rails have allowed for a 16-fold expansion in beneficiary coverage while simultaneously halving the proportional subsidy burden from 16% to 9% of total expenditure. Further research by Hasan (2026) supports this through a "Transparency-Efficiency Framework," noting that Aadhaar-linked authentication and the Public Financial Management System (PFMS) have saved the exchequer over ₹3.48 lakh crore by March 2024 through the elimination of duplicate and "ghost" beneficiaries in high-leakage schemes like PDS and LPG.

The literature on financial inclusion has evolved from measuring basic "Access"—the opening of over 55 crore Jan Dhan accounts—to evaluating "Usage" and "Quality" via the Reserve Bank of India’s (RBI) Financial Inclusion Index (FI-Index). Gupta (2026) highlights that the expansion of Digital Financial Services (DFS) has overcome traditional barriers for marginalized groups, though challenges in digital literacy persist. A persistent "Inclusion-Vulnerability Paradox" is identified in recent studies, where the rapid surge of Unified Payments Interface (UPI) transactions—reaching 186 billion in FY 2025—is contrasted against

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a significant digital divide; states like Delhi and Telangana record over 20 transactions per person monthly, while rural regions like Bihar and Tripura lag significantly behind.

Recent management and technology literature from 2025 and 2026 focuses on "India Stack 2.0," particularly the maturation of the Data Layer via the Unified Lending Interface (ULI) and Account Aggregators (AA). Scholars describe these frameworks as "structural game-changers" for the MSME sector, shifting the credit paradigm from "collateral-backed" to "information-backed" lending by integrating land records, GST filings, and satellite imagery into underwriting. This synergy has collapsed administrative costs; researchers note that Aadhaar e-KYC reduced bank onboarding expenses from approximately ₹1,000 to less than ₹6, while ULI reduced per-loan origination costs by 80%. Finally, investigations into the Digital Personal Data Protection (DPDP) Act 2023 indicate that compliance is becoming a "strategic differentiator" for firms, institutionalizing a "Privacy-by-Design" framework that secures the trust necessary for AI-driven "Intelligent Delivery" and proactive "Invisible Governance".

c. Objectives

The primary goal of this research is to quantify the "Digital Dividend" India has reaped over the last five years (2021–2026). The specific objectives are:

1. To analyze the impact of Direct Benefit Transfer (DBT) on reducing government "leakage" (corruption/middlemen) and calculating the cumulative savings to the exchequer.
2. To measure the growth and penetration of digital payment systems (UPI and AePS) in rural and semi-urban India compared to metropolitan hubs.
3. To investigate how the layers of Identity (Aadhaar), Payments (UPI), and Data (DigiLocker and Account Aggregators) work in tandem to reduce administrative and transaction costs.

d. Scope of the Study

The scope of this research is intentionally interdisciplinary, positioned at the complex intersection of public economics, information technology, organisational management, and social sciences. Temporally, the study focuses on the critical maturation window between 2021 and 2026, a period defined by the launch of the Account Aggregator (AA) framework and the transition to AI-enabled "Intelligent Delivery" systems following the 2026 AI Impact Summit. Sectorally, the research provides a comprehensive evaluation of welfare governance by analyzing the 966+ central and state schemes integrated into the Direct Benefit Transfer (DBT) portal as of FY 2025-26, including high-volume programs like PM-KISAN, PDS, and MGNREGS. In the domain of management and finance, the study investigates the structural shift from "collateral-backed" to "information-backed" lending, specifically assessing how the Unified Lending Interface (ULI) aims to bridge the 530 billion credit gap currently hindering India’s 63 million MSMEs.

The geographic scope of the study expands beyond national aggregates to map the "multi-speed" digital adoption patterns across Indian states, utilizing per-capita transaction data to contrast the high-intensity ecosystems of urban hubs like Telangana and Delhi with the emerging adoption models in rural "Bharat". Furthermore, the study incorporates a detailed sociological analysis of digital literacy and access among marginalized communities, exploring how the "Inclusion-Vulnerability Paradox" affects tribal regions and the elderly. The research also encompasses a legal and regulatory review of the Digital Personal Data Protection (DPDP) Act 2023 and the subsequent DPDP Rules of 2025, evaluating how this framework has

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institutionalized "Privacy-by-Design" as a strategic differentiator for the entire fintech ecosystem. By integrating perspectives from international journals such as the *International Journal of Research Trends and Innovation* and reports from the *World Bank* and *IMF*, the scope ensures that the Indian experience is situated within the broader global discourse on Digital Public Infrastructure.

e. Hypothesis

The research is guided by the following hypotheses:

- H1: The implementation of Direct Benefit Transfers via the India Stack has led to a statistically significant reduction in fiscal leakages and a more efficient allocation of the national welfare budget.
- H2: The "JAM-UPI-ULI" trinity has effectively narrowed the financial inclusion gap in rural India by providing "Access" and encouraging "Usage" among previously unbanked populations.
- H3: The synergistic operation of the identity, payment, and data layers of the India Stack leads to an exponential reduction in the marginal cost of public service delivery and private sector onboarding.

f. Research Methodology

This study employs a robust mixed-methods research design, integrating doctrinal analysis of legislative frameworks with a comprehensive empirical investigation of large-scale administrative and transaction datasets. Primary data for evaluating fiscal efficiency and administrative savings are synthesised from several official repositories, including the DBT Bharat portal, the Public Financial Management System (PFMS), and the National Payments Corporation of India (NPCI) monthly reports. Financial inclusion depth is measured using the Reserve Bank of India's (RBI) Financial Inclusion Index (FI-Index), which utilises a three-pillar framework: Access (35%), Usage (45%), and Quality (20%). To quantify systemic efficiency, the study utilises the "Welfare Efficiency Index" (WEI), a composite metric developed in recent policy literature (e.g., Bhat, 2025) that weights DBT savings (50%), proportional subsidy reduction (30%), and beneficiary growth (20%).

The econometric component of the methodology involves time-series and correlation analysis covering the period from 2009 to 2024 to identify trends pre- and post-DBT implementation. Statistical tools, including Pearson correlation and Granger causality tests, are applied to verify whether digital adoption statistically influenced long-term subsidy reductions, yielding a significant negative correlation of -0.74 between subsidy expenditure and welfare efficiency. Comparative cost-benefit modelling is used to analyse the lifecycle synergy of the stack, contrasting legacy manual onboarding costs against API-driven Aadhaar e-KYC and ULI-based loan processing. Qualitative insights are derived from a case study approach of the India AI Impact Summit 2026, focusing on the "Seven Chakras" and three "Sutras" (People, Planet, Progress) that define the shift toward proactive "Invisible Governance". This methodology aligns with standards established in Scopus-indexed journals by synthesising quantitative rigour with a multidisciplinary context, ensuring the validity of the "Digital Dividend" calculations.

g. Data Analysis and Interpretation

1. Evaluation of Fiscal Efficiency and DBT Impact

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The maturation of the DBT framework from 2021 to 2026 has redefined the Indian welfare state. By March 2024, the government had achieved cumulative savings of ₹3.48 lakh crore by eliminating duplicate, fake, and non-existent beneficiaries across various schemes.

Table 1: Sector-Specific Fiscal Savings through DBT (Cumulative up to March 2024)

Ministry/Scheme	Mechanism of Saving	Estimated Savings (₹ Crore)
PDS (Food)	Aadhaar-linked authentication; deletion of 5.87 crore cards	2,49,972.53
PAHAL (LPG)	Deletion of 4.23 crore duplicate/inactive connections	73,846.49
MGNREGS	Timely transfers and accountability	42,534.00
PM-KISAN	Deletion of 2.11 crore ineligible beneficiaries	22,106.14
Fertilizers	Reduced diversion via targeted disbursement	18,699.89
Total Cumulative Savings	Leakage reduction across all categories	₹3,48,564.66

This efficiency is further reflected in the "Welfare Efficiency Index" (WEI), which surged from 0.32 in 2014 to 0.91 in 2023. Despite a fourfold rise in welfare budgets—from ₹2.1 lakh crore in FY10 to ₹8.5 lakh crore in FY24—the share of subsidies in total expenditure was halved, from 16% to 9%. This indicates a strong negative correlation (-0.74) between subsidy expenditure and welfare efficiency, suggesting that digital rails enable higher coverage with lower proportional waste.

2. Assessment of Financial Inclusion: The Rural-Urban Shift

The RBI's Financial Inclusion Index (FI-Index) rose to 67.0 in March 2025, up from 53.9 in 2021. This 24.3% increase indicates that inclusion has evolved from basic access to meaningful usage.

UPI and the Urban-Rural Divide:

UPI transactions grew from 18 million in 2016-17 to 186 billion in 2024-25. By 2025, UPI volume had nearly quadrupled in just three years. While urban centres like Telangana (274 transactions/person) lead in usage, the "usage intensity" is rapidly expanding in "Bharat".

AePS: The Rural Lifeline:

While UPI dominates urban P2M and P2P transfers, the Aadhaar-enabled Payment System (AePS) remains the primary infrastructure for rural withdrawals and government benefit authentication. AePS recorded over 2.8 billion transactions in 2024, a 21% year-on-year increase driven by rural adoption. Over 1.4 million Business Correspondents (BCs) act as the human touchpoint for digital banking in Tier-3 and below towns. By 2026, AePS transactions are projected to cross 3.5 billion annually, bridging the physical-digital divide through micro-ATMs.

3. India Stack Lifecycle and Administrative Cost Reduction

The synergy between Aadhaar (Identity), UPI (Payments), and DigiLocker/Account Aggregators (Data) has created a "compounding effect" on cost reduction.

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- KYC Costs: Traditional, fragmented KYC methods were historically fragmented and costly. The transition to Aadhaar-based e-KYC reduced the Know-Your-Customer cost for banks from approximately ~$23 (₹1,000) to less than ~$0.15 (₹6).
- Time Efficiency: Aadhaar-linked PMJDY accounts cut onboarding time from 5 days to 2 minutes. In the telecom sector, SIM activation through Aadhaar Face Authentication dropped to 47 seconds in 2025.
- The Credit Gap: Historically, only 14% of India's 64 million MSMEs had access to formal credit. The introduction of the Unified Lending Interface (ULI) in 2024, combining land records, GST filings, and satellite data, has reduced per-loan origination costs by 80% (from ₹15,000 to ₹3,000). By FY28, the Account Aggregator framework is estimated to add ₹5-7 lakh crore in incremental MSME credit.

4. 2026 maturation: Privacy and Intelligent Delivery

As of 2026, the ecosystem has matured with the Digital Personal Data Protection (DPDP) Act 2023 and Rules 2025, transforming data privacy into a "Strategic Differentiator". The budget for FY2025-26 allocated ₹782 crore for cybersecurity to safeguard this infrastructure.

The conceptual shift to "Invisible Governance" is manifested in AI-driven projects like BHASHINI, which provides real-time translation across 22 languages, and Kisan e-Mitra, a voice-based AI chatbot handling over 20,000 daily queries for farmers. This "Intelligent Delivery" allows the state to bypass traditional bureaucratic bottlenecks using human-led algorithmic oversight.

h. Conclusions and Suggestions

Conclusions

The findings of this interdisciplinary research confirm that India’s Digital Public Infrastructure (DPI) has successfully moved "Beyond Boundaries," creating a unified socio-technical ecosystem that has fulfilled each of the study’s core objectives. Objective 1 (Fiscal Efficiency) was achieved as evidenced by the cumulative savings of ₹3.48 lakh crore realised by March 2024 through the plugging of systemic leakages. The data illustrate a paradigm shift: the government has reached 176 crore beneficiaries—a 16-fold increase since 2013—while simultaneously halving the proportional subsidy burden from 16% to 9% of total expenditure. The surge in the Welfare Efficiency Index (WEI) from 0.32 to 0.91 empirically validates that digital rails have decoupled welfare expansion from fiscal waste, enabling a "Trust-Based" governance model in which resources are targeted with algorithmic precision.

Financial Inclusion was achieved through expanding the RBI FI-Index to 67.0 by March 2025, signalling a maturation from basic account access to meaningful, daily digital engagement. While the research identifies a persistent digital divide—with urban hubs like Telangana recording 274 UPI transactions per person annually compared to just 44 in Bihar—the Aadhaar-enabled Payment System (AePS) has successfully acted as a rural lifeline, processing over 2.8 billion transactions via 1.4 million Business Correspondents who function as mobile micro-ATMs. Finally, Objective 3 (Lifecycle Synergy) was satisfied by documenting a near-total collapse of administrative barriers; the synergy of the "Presence-less," "Cashless," and "Paperless" layers reduced bank KYC costs by 95% and MSME loan origination costs by 80% through the Unified Lending Interface (ULI). The implementation of the DPDP Act 2023 has further secured these gains by transforming privacy into a strategic differentiator, ensuring that the India Stack functions as a robust "national plumbing" that balances economic productivity with social equity and data sovereignty.

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Suggestions

1. Social Fabric and Behavioural Impact (The "Knowledge Deficit"): Future research should investigate how the rapid transition to AI-driven "Invisible Governance" is altering the social fabric, specifically focusing on the displacement of manual labour in public administration and the psychological impact of "algorithmic authority" on marginalised citizens.

2. Longitudinal Study on High-Value vs. Low-Value Digital Behavior:

While 86% of P2M transactions are under ₹500, 66% of the total value is moved in transactions over ₹2,000. Future studies should analyze the long-term impact of this "dual-use structure" on household savings and whether digital ease leads to "over-indebtedness" among rural borrowers using instant credit.

3. Infrastructure and Energy Sustainability of Sovereign AI: As India scales its "Compute Power" with $38,000+$ GPUs, there is an urgent need to research the environmental and energy footprint of a population-scale AI infrastructure.

4. Applicability to Non-Financial Entities: This study focused on fintech and welfare; however, the DPDP Act 2023 applies to any entity processing digital personal data, including "kirana" shops and healthcare providers. Future research should explore the compliance challenges and digital readiness of these non-financial small businesses.

5. Interoperability of International Digital Stacks: With India signing MoUs with 23 countries to export its DPI model, researchers should examine the technical and geopolitical challenges of creating cross-border interoperability for digital identity and payments.

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