



Digital Public Infrastructure and Economic Growth in India: Evidence from The Digital India Programme

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ABSTRACT

Digital Public Infrastructure (DPI) has become a strategic foundation for digital transformation, financial inclusion, and institutional modernisation in emerging economies. India has developed one of the world's largest DPI ecosystems through the Digital India programme by integrating digital identity, interoperable payment systems, broadband connectivity, and digital public services. This study examines the evolution of India's DPI and its association with macroeconomic performance using nationally representative secondary data from TRAI, UIDAI, NPCI, RBI, and MoSPI. Four key indicators—Internet subscribers, Aadhaar authentication transactions, Unified Payments Interface (UPI) transaction value, and the Reserve Bank of India Digital Payments Index (RBI-DPI)—are analysed alongside Gross Domestic Product (GDP) using trend analysis, descriptive statistics, and Compound Annual Growth Rate (CAGR). The findings reveal sustained growth across all DPI indicators, with UPI exhibiting the fastest expansion, reflecting rapid adoption of interoperable digital payments. Internet connectivity and Aadhaar authentication also expanded substantially, strengthening digital governance, financial inclusion, and access to public services. Although the study does not establish causal relationships, the concurrent growth of DPI indicators and GDP suggests that integrated digital public systems contribute to institutional efficiency, lower transaction costs, and broader economic participation. The study contributes updated macro-level evidence on India's Digital Public Infrastructure and offers policy insights for strengthening inclusive, secure, and sustainable digital development.

Keywords: Digital Public Infrastructure; Digital India; Economic Growth; Financial Inclusion; Digital Governance.

INTRODUCTION

Digital transformation has become a defining feature of contemporary economic development, reshaping production systems, public administration, financial services, and citizen–government interactions. Advances in broadband connectivity, digital identity, interoperable payment systems, and data-driven governance have reduced transaction costs, expanded access to markets and public services, and improved institutional efficiency. Consequently, digital technologies are increasingly recognised not only as drivers of productivity and innovation but also as critical enablers of inclusive and sustainable development, particularly in emerging economies where they can help overcome longstanding infrastructural and institutional constraints (OECD, 2024a; Clark et al., 2025).

Within this broader transformation, Digital Public Infrastructure (DPI) has emerged as a new paradigm for digital development. Unlike conventional digital infrastructure, which primarily provides connectivity, DPI comprises interoperable public digital systems for digital identity, digital payments, and trusted data exchange that enable governments, businesses, and citizens to interact securely and efficiently. By integrating technological capabilities with institutional arrangements, DPI improves public service delivery, strengthens financial inclusion, supports innovation, and lowers barriers to economic participation (Clark et al., 2025; World Bank, 2024). Increasing international evidence suggests that well-designed DPI ecosystems enhance governance, improve economic resilience, and create favourable conditions for long-term development.

India represents one of the most comprehensive examples of DPI-led transformation. Since the launch of the Digital India programme in 2015, the country has developed an integrated digital ecosystem centred on Aadhaar, the Unified Payments Interface (UPI), Direct Benefit Transfer (DBT), DigiLocker, FASTag, the Account Aggregator framework, and rapidly expanding broadband connectivity. Together, these interoperable platforms have transformed public service delivery, accelerated digital financial inclusion, expanded digital commerce, and strengthened interactions between citizens and the state. In particular, UPI has revolutionised retail payments by enabling secure, real-time, low-cost, and interoperable transactions at an unprecedented scale, positioning India as the global leader in real-time digital payments (RBI, 2025; NPCI, 2025).

India's digital architecture proved especially resilient during the COVID-19 pandemic. Digital identity, interoperable payment systems, and online public services ensured continuity in welfare delivery, healthcare, commercial transactions, and public administration despite severe mobility restrictions. Consequently, India's experience has attracted considerable international attention as a scalable model for inclusive digital transformation, with several countries exploring similar public digital systems (OECD, 2024b; World Bank, 2024).

The economic significance of Digital India extends beyond technological adoption. Digital connectivity expands participation in the digital economy; trusted digital identity lowers verification and compliance costs; interoperable payment systems improve market efficiency by reducing transaction costs; and integrated digital governance enhances institutional effectiveness and service delivery. Acting together, these complementary platforms generate network effects that strengthen productivity, promote innovation, expand financial inclusion, and facilitate broader economic participation. This perspective is consistent with endogenous growth theory, which emphasises technological innovation and institutional quality as fundamental drivers of sustained economic growth (Lucas, 1988; Romer, 1990).

Despite growing scholarly interest in digital transformation, important gaps remain in the literature. Most empirical studies examine broadband connectivity, digital identity, digital payments, financial inclusion, or e-governance independently, offering limited insight into how these components function collectively as an integrated Digital Public Infrastructure ecosystem. Furthermore, relatively few studies provide recent macro-level assessments that simultaneously examine the evolution of multiple dimensions of India's DPI alongside aggregate economic performance using nationally representative official data. Much of the available evidence also predates the rapid expansion of UPI, the acceleration of digital adoption following the COVID-19 pandemic, and the emergence of DPI as a globally recognised development paradigm.

This study addresses these gaps by examining the evolution of India's Digital Public Infrastructure and its association with macroeconomic performance through an integrated analytical framework. Using nationally representative secondary data from the Telecom Regulatory Authority of India (TRAI), the Unique Identification Authority of India (UIDAI), the National Payments Corporation of India (NPCI), the Reserve Bank of India (RBI), and the Ministry of Statistics and Programme Implementation (MoSPI), the study analyses four core dimensions of DPI—Internet subscribers, Aadhaar authentication transactions, UPI transaction

value, and the Reserve Bank of India Digital Payments Index (RBI-DPI)—alongside Gross Domestic Product (GDP). Employing trend analysis, descriptive statistics, and Compound Annual Growth Rate (CAGR), the study provides updated macro-level evidence on the evolution of India's Digital Public Infrastructure. Although the analysis does not seek to establish causal relationships, it offers a comprehensive assessment of how India's interconnected digital public systems have evolved alongside economic growth and contributes to the emerging literature on Digital Public Infrastructure, institutional development, and inclusive economic transformation.

Objectives of the Study

This study aims to assess the evolution of India's Digital Public Infrastructure (DPI) and examine its association with macroeconomic performance under the Digital India programme. Specifically, the study seeks to:

1. Analyse the growth trajectories of key Digital Public Infrastructure indicators, namely Internet subscribers, Aadhaar authentication transactions, Unified Payments Interface (UPI) transaction value, and the Reserve Bank of India Digital Payments Index (RBI-DPI);
2. Examine the temporal association between the expansion of these Digital Public Infrastructure indicators and India's real Gross Domestic Product (GDP);
3. Compare the long-term growth performance of the selected Digital Public Infrastructure indicators and GDP using descriptive statistics and Compound Annual Growth Rate (CAGR); and
4. Discuss the implications of India's Digital Public Infrastructure for digital transformation, financial inclusion, governance, and sustainable economic development.

LITERATURE REVIEW AND RESEARCH GAP

Technological innovation has long been recognised as a fundamental driver of economic growth and structural transformation. While the neoclassical growth model attributes long-run productivity growth to exogenous technological progress (Solow, 1956), endogenous growth theory argues that sustained economic development results from investments in

knowledge, innovation, human capital, and institutions that continuously generate technological change (Lucas, 1988; Romer, 1990). Earlier, Schumpeter (1934) emphasised innovation and entrepreneurship as the engines of economic transformation through creative destruction, whereas institutional economists have highlighted that the developmental impact of technological progress depends critically on the quality of governance and public institutions (Acemoglu & Robinson, 2012). Collectively, these perspectives suggest that technology contributes to development not merely through invention but through institutional arrangements that facilitate its widespread adoption and productive use.

The digital revolution has substantially strengthened this institutional dimension of technological change. Unlike conventional physical infrastructure, digital infrastructure generates network effects that reduce transaction costs, improve information flows, facilitate innovation, and expand access to markets and public services. Brynjolfsson and McAfee (2014) argue that digital technologies have fundamentally transformed production systems, organisational efficiency, and labour markets, while Jorgenson and Vu (2016) identify information and communication technologies (ICT) as a major source of productivity growth across developed and emerging economies. Similarly, empirical evidence from OECD countries demonstrates that broadband infrastructure positively influences economic performance by enhancing productivity, innovation, and business competitiveness (Koutroumpis, 2019). These findings indicate that digital infrastructure has evolved from a supporting technological asset into a strategic enabler of long-term economic development.

Building on this evolution, Digital Public Infrastructure (DPI) has emerged as a distinct framework for digital transformation. Unlike conventional digital infrastructure, which primarily focuses on connectivity, DPI comprises interoperable public digital systems that provide foundational capabilities for digital identity, digital payments, and trusted data exchange. Clark et al. (2025) define DPI as interoperable digital platforms that enable secure interactions among governments, businesses, and citizens, while the World Bank (2024) and OECD (2024a, 2024b) emphasise its role in improving governance, reducing transaction costs, strengthening financial inclusion, and enhancing public service delivery. The defining feature of DPI lies in its interoperability. Rather than functioning as isolated technological applications, its constituent platforms reinforce one another through network effects that expand digital participation and institutional efficiency. Consequently, the developmental significance of DPI extends beyond technological adoption to encompass institutional transformation.

A growing body of empirical evidence supports the proposition that digital technologies influence economic development through multiple complementary channels. Digital connectivity reduces information asymmetries, facilitates knowledge diffusion, improves resource allocation, and expands participation in digital markets (Koutroumpis, 2019; OECD, 2024a). However, the benefits of connectivity remain unevenly distributed. Van Dijk (2020) argues that the digital divide is no longer limited to disparities in physical access but increasingly reflects differences in digital capabilities, effective usage, and socio-economic opportunities. This suggests that investments in digital infrastructure alone are insufficient unless paired with policies that build digital literacy and ensure equitable access.

Digital financial inclusion represents another important mechanism linking digital transformation with economic development. The Global Findex Database demonstrates that digital financial services have significantly expanded access to formal financial systems, particularly in developing economies, enabling households and businesses to save, invest, access credit, and manage financial risks more effectively (Demirgüç-Kunt et al., 2022). Earlier studies similarly report that efficient retail payment systems improve market efficiency by lowering transaction costs and facilitating commercial exchange (Hasan et al., 2013). Evidence from Kenya further shows that mobile money substantially reduced poverty and strengthened household resilience by expanding financial inclusion (Suri & Jack, 2016). Together, these studies indicate that interoperable payment systems generate developmental benefits that extend beyond payment efficiency to broader economic participation and welfare improvement.

Digital identity constitutes an equally important pillar of Digital Public Infrastructure because trusted identification systems enable secure access to financial services, welfare programmes, taxation, healthcare, and digital governance. Muralidharan et al. (2016) demonstrate that biometric identification significantly improves the efficiency of public service delivery by reducing administrative leakages and strengthening state capacity. India's Aadhaar system exemplifies this transformation by enabling electronic Know Your Customer (e-KYC), Direct Benefit Transfers (DBT), and authentication across a wide range of public and private services. At the same time, the rapid expansion of digital identity has intensified concerns regarding privacy, cybersecurity, data governance, and institutional accountability. Sasi (2025), together with the World Bank (2024) and OECD (2024b), argues that public trust in digital

identity systems ultimately depends on transparent governance, effective legal safeguards, and robust data protection frameworks.

India has become one of the world's leading examples of Digital Public Infrastructure through the Digital India programme. Flagship initiatives—including Aadhaar, the Unified Payments Interface (UPI), DigiLocker, Direct Benefit Transfer, FASTag, and the Account Aggregator framework—have collectively established an integrated digital ecosystem that connects citizens, businesses, and government agencies through interoperable public platforms. International organisations increasingly recognise India's DPI architecture as a scalable model for inclusive digital transformation, particularly for developing economies seeking to modernise governance and expand financial inclusion (Clark et al., 2025; OECD, 2024a; World Bank, 2024). Among these initiatives, UPI has attracted particular scholarly attention because of its unprecedented scale and rapid adoption. Kiran and Sailaja (2025) demonstrate that perceived usefulness, facilitating conditions, trust, and behavioural intention significantly influence sustained UPI usage, while Chopra et al. (2026) show that the integration of digital identity, interoperable payments, and public service delivery has substantially strengthened financial inclusion in India. These studies collectively suggest that the success of India's digital transformation stems not simply from technological innovation but from institutional coordination, interoperability, supportive regulation, and widespread public adoption.

Despite the rapid expansion of research on digital transformation, three important gaps remain. First, most empirical studies investigate broadband connectivity, digital identity, digital payments, financial inclusion, or e-governance as separate domains, providing fragmented evidence on the functioning of Digital Public Infrastructure as an integrated ecosystem. Second, relatively few macro-level studies examine the joint evolution of multiple DPI components alongside aggregate economic performance using recent nationally representative official data. Third, much of the available evidence predates the post-pandemic acceleration of digital adoption and the emergence of DPI as a globally recognised development paradigm. Addressing these gaps, the present study develops an integrated analytical framework that examines four complementary dimensions of India's Digital Public Infrastructure—digital connectivity, digital identity, interoperable digital payments, and digital payment ecosystem development—and analyses their evolution alongside Gross Domestic Product (GDP) using official data from TRAI, UIDAI, NPCI, RBI, and MoSPI. By conceptualising DPI as an interconnected institutional ecosystem rather than a collection of isolated digital initiatives, the

study provides updated macro-level evidence on the Digital India programme and contributes to the growing literature on digital transformation, institutional development, and inclusive economic growth.

MATERIALS AND METHOD

This study adopts a quantitative descriptive–analytical research design to examine the evolution of India's Digital Public Infrastructure (DPI) and its association with macroeconomic performance under the Digital India programme. The analysis is based exclusively on nationally representative secondary data obtained from official government institutions, namely the Telecom Regulatory Authority of India (TRAI), the Unique Identification Authority of India (UIDAI), the National Payments Corporation of India (NPCI), the Reserve Bank of India (RBI), and the Ministry of Statistics and Programme Implementation (MoSPI). These sources provide reliable and publicly accessible statistics on India's digital infrastructure and economic performance. The longest comparable time series available for each indicator is utilised, with minor variations in the observation period reflecting differences in data availability.

The study employs Gross Domestic Product (GDP) at constant (2011–12) prices as the indicator of macroeconomic performance and four indicators representing the principal dimensions of India's Digital Public Infrastructure: Internet subscribers (digital connectivity), Aadhaar authentication transactions (digital identity), Value of Unified Payments Interface (UPI) transactions (interoperable digital payments), and the Reserve Bank of India Digital Payments Index (RBI-DPI), which captures the maturity of the digital payments ecosystem. Together, these indicators provide a multidimensional representation of India's DPI using nationally comparable official statistics.

The analytical framework is grounded in the proposition that Digital Public Infrastructure functions as an institutional mechanism through which digital connectivity, trusted digital identity, interoperable payment systems, and digital governance enhance institutional efficiency, reduce transaction costs, strengthen financial inclusion, and facilitate broader participation in the digital economy. Within this framework, GDP is treated as a macroeconomic outcome associated with the progressive expansion of complementary digital public platforms, while recognising that economic growth is simultaneously influenced by numerous structural and macroeconomic factors beyond the scope of the present study.

The analysis employs trend analysis, descriptive statistics, and Compound Annual Growth Rate (CAGR). Trend analysis is used to examine the temporal evolution of the selected indicators, while descriptive statistics, including the mean, standard deviation, and coefficient of variation, summarise their central tendency and variability. CAGR is calculated to estimate the average annual growth of each indicator, enabling meaningful comparison across variables measured in different units and observed over different time periods. As the analysis is descriptive and comparative in nature, the findings are interpreted as evidence of temporal association rather than causal relationships between Digital Public Infrastructure and macroeconomic performance.

RESULTS AND DISCUSSION

Evolution of India's Digital Public Infrastructure

The analysis reveals sustained expansion across all four dimensions of India's Digital Public Infrastructure (DPI), namely digital connectivity, digital identity, interoperable digital payments, and digital payment ecosystem development. Although these indicators differ in their rates of growth, they collectively demonstrate the progressive consolidation of an integrated digital ecosystem following the implementation of the Digital India programme. The concurrent expansion of these complementary platforms suggests that India's digital transformation has evolved through mutually reinforcing institutional and technological developments rather than isolated policy interventions.

Digital Connectivity

As shown in Table 1 and Figure 1, internet subscriptions increased from 342.65 million in 2015–16 to 969.10 million in 2024–25, representing nearly a threefold increase over the study period. This expansion reflects sustained investments in broadband infrastructure, declining mobile data costs, wider smartphone adoption, and policy initiatives implemented under the Digital India programme. Although subscriber growth moderated after 2021, indicating a gradual transition towards market maturity, the overall trajectory demonstrates the continued expansion of India's digital access infrastructure.

Table 1: *Internet Subscribers (31st March 2016 – 31st March 2025)*

<i>Year</i>	<i>Total Internet users (Million)</i>
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2015-16	342.65
2016-17	422.19
2017-18	493.96
2018-19	636.73
2019-20	743.19
2020-21	825.30
2021-22	824.89
2022-23	881.25
2023-24	954.40
2024-25	969.10

Source: Telecom Regulatory Authority of India (TRAI), Government of India

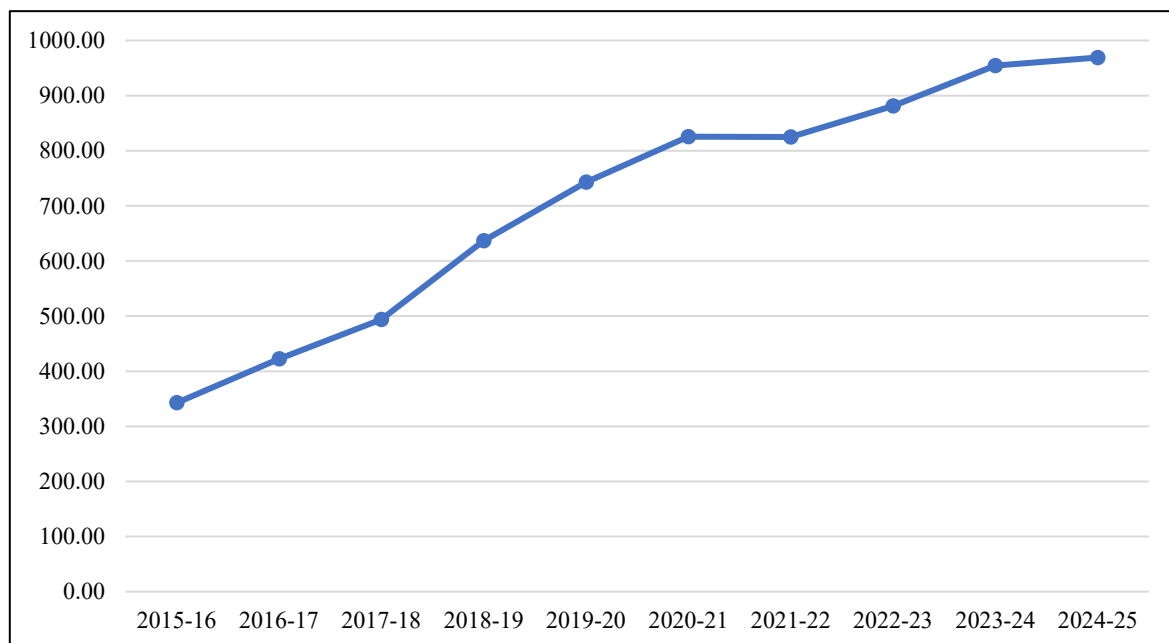


Figure 1: Growth of Internet Subscribers

The findings support previous evidence that broadband connectivity constitutes the foundational layer of digital transformation by enabling access to digital markets, financial services, e-governance, healthcare, and education (Koutroumpis, 2019; OECD, 2024). They also reinforce the proposition that investments in digital connectivity generate positive spillover effects by facilitating adoption of complementary digital platforms, including digital

identity and interoperable payment systems. Consequently, expanding affordable and reliable Internet access remains essential for ensuring that the benefits of Digital Public Infrastructure are distributed inclusively across regions and socio-economic groups.

Digital Identity

Aadhaar authentication transactions increased from 1.04 billion in 2015–16 to 22.38 billion in 2024–25 (Table 2 and Figure 2), reflecting the increasing institutionalisation of digital identity across governance, financial services, and public administration. Beyond serving as a unique identification mechanism, Aadhaar has evolved into foundational public infrastructure that supports authentication for welfare programmes, banking, taxation, healthcare, and electronic Know Your Customer (e-KYC) services.

Table 2: *Aadhaar Authentication Transactions*

<i>Year</i>	<i>Aadhaar Authentication (Yes/No) transactions (Million)</i>
2015-16	1043.80
2016-17	2950.40
2017-18	8769.60
2018-19	8744.80
2019-20	10241.30
2020-21	13021.50
2021-22	15323.80
2022-23	19690.00
2023-24	21916.30
2024-25	22379.40

Source: Unique Identification Authority of India (UIDAI) Annual Report 2024-25.

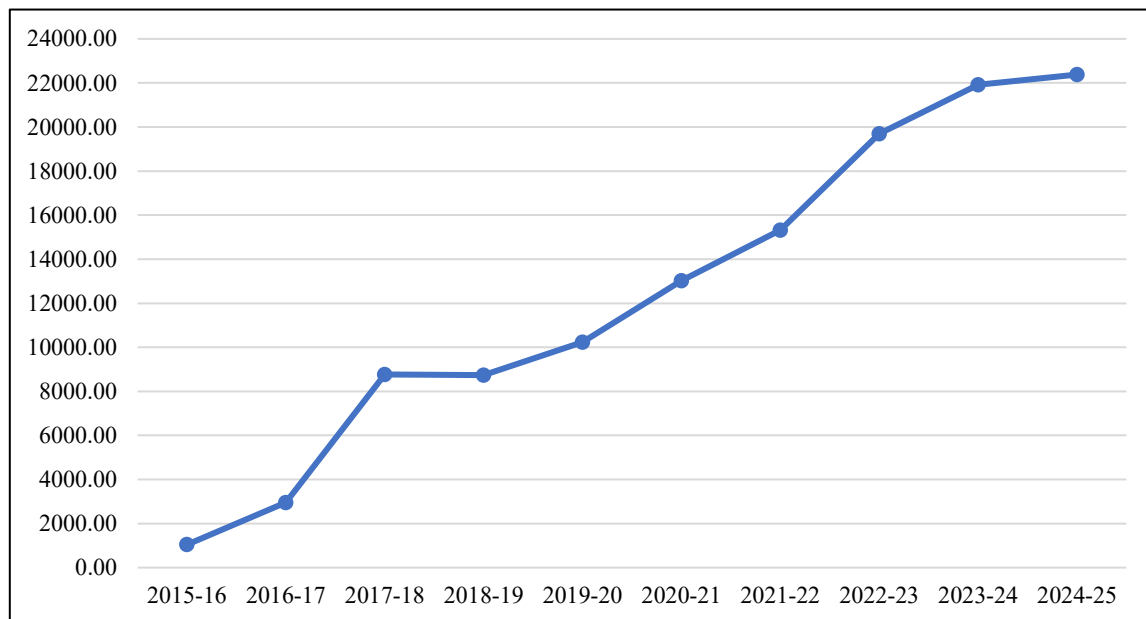


Figure 2: Growth of Aadhaar Authentication Transactions

These findings broadly align with earlier evidence showing that digital identity systems improve targeting efficiency, reduce administrative leakages, and expand access to public services (Muralidharan et al., 2016). They also align with more recent scholarship emphasising that the developmental impact of digital identity depends not only on technological capability but also on robust governance frameworks that protect privacy, strengthen cybersecurity, and maintain public trust (Sasi, 2025; World Bank, 2024). Accordingly, continued expansion of Aadhaar-based services should be accompanied by strong safeguards for data governance and institutional accountability.

Digital Payments

Among the selected indicators, UPI recorded the most remarkable growth. As presented in Table 3 and Figure 3, annual transaction value increased from ₹24.25 billion in 2017 to ₹24,772.22 billion in 2025, reflecting the rapid adoption of interoperable, real-time digital payments across households, businesses, and government agencies. Several factors appear to have contributed to this expansion, including affordable internet access, widespread smartphone penetration, supportive regulatory policies, increasing merchant acceptance, and continuous innovation within India's fintech ecosystem.

Table 3: Value of UPI Transactions

<i>Period</i>	<i>Value (₹ Billion)</i>
March 2017	24.25
March 2018	241.73
March 2019	1334.61
March 2020	2064.62
March 2021	5048.86
March 2022	9605.82
March 2023	14104.43
March 2024	19783.53
March 2025	24772.22

Source: National Payments Corporation of India (NPCI)

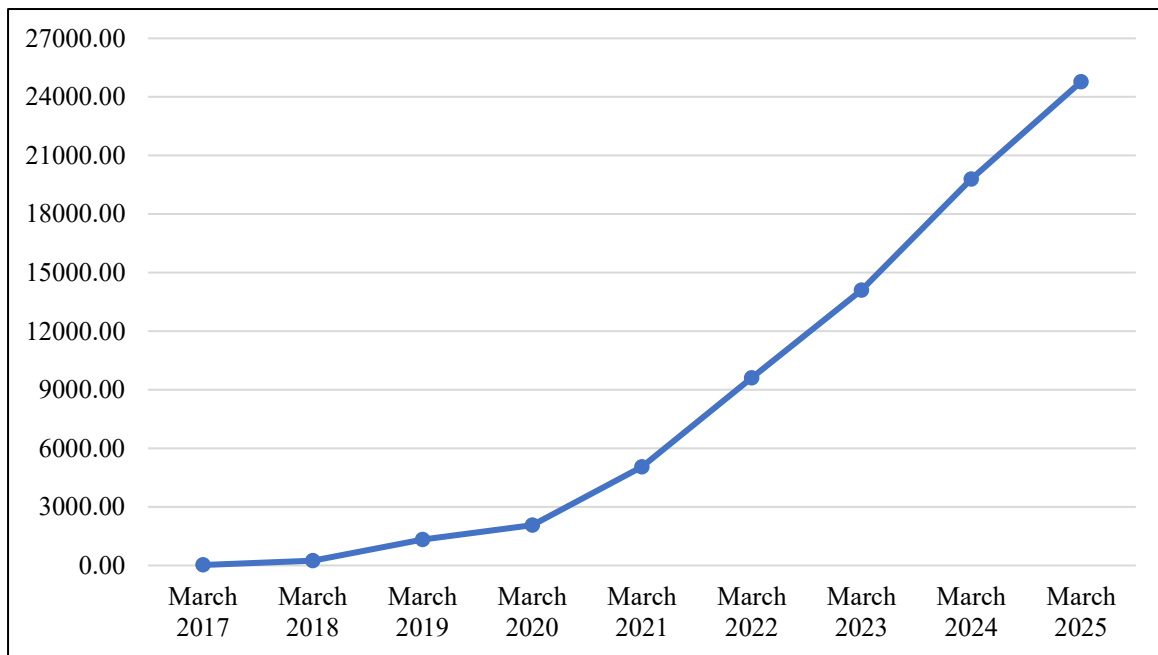


Figure 3: Growth of UPI Transactions

UPI's exceptional growth shows how interoperable public payment infrastructure can substantially reduce transaction costs while accelerating financial inclusion and digital commerce. The findings align with Kiran and Sailaja (2025), who report that sustained UPI adoption is driven not only by technological efficiency but also by perceived usefulness, facilitating conditions, user trust, and behavioural intention. Together, these observations suggest that the success of digital payment ecosystems depends on the interaction between

technological innovation, institutional design, and user acceptance rather than technological capability alone.

Digital Payment Ecosystem Development

As shown in Table 4 and Figure 4, the RBI Digital Payments Index increased steadily from its base value of 100 in 2018 to 493.22 in 2025, indicating continuous improvements in payment infrastructure, institutional readiness, consumer adoption, and transaction performance. Unlike UPI transaction values, which primarily reflect transaction volumes, the RBI-DPI provides a broader measure of India's digital payment ecosystem maturity.

Table 4: *RBI Digital Payments Index*

<i>Period</i>	<i>RBI-DPI</i>
March 2018	100 (Base)
March 2019	153.47
March 2020	207.84
March 2021	270.59
March 2022	349.30
March 2023	395.57
March 2024	445.50
March 2025	493.22

Source: Reserve Bank of India

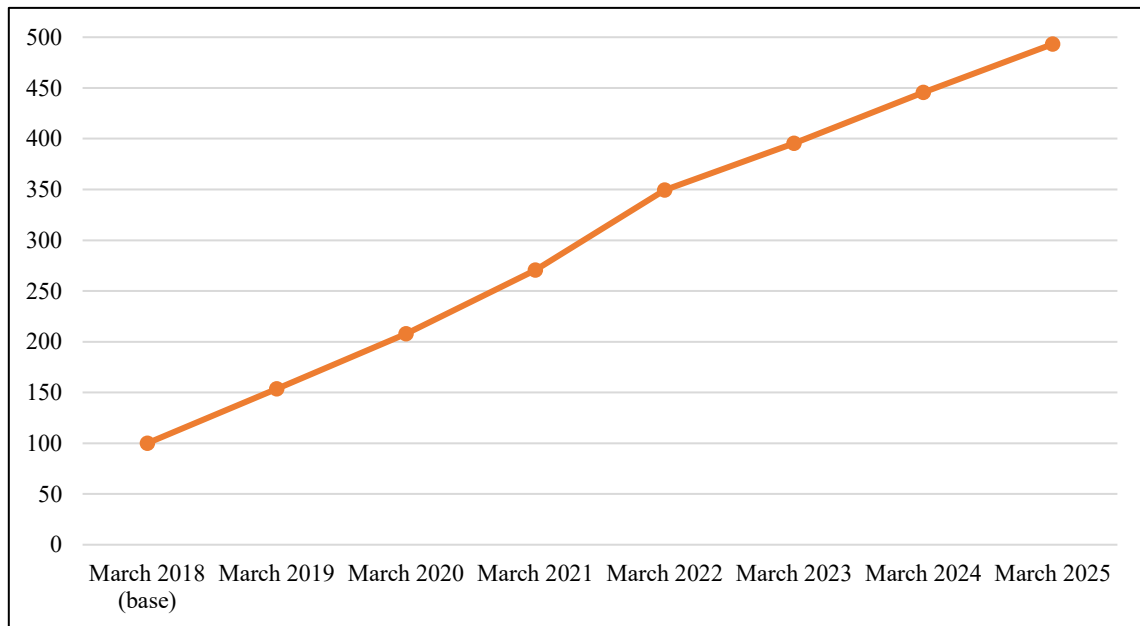


Figure 4: Growth Trend of RBI's Digital Payments Index

The index's sustained growth suggests India's payment ecosystem has evolved in a balanced way, with simultaneous improvements in infrastructure, institutional support, consumer adoption, and transaction efficiency. These findings reinforce recent evidence that interoperable Digital Public Infrastructure generates stronger developmental outcomes when complementary digital platforms evolve together as an integrated ecosystem rather than independently (Chopra et al., 2026).

Taken together, the four indicators demonstrate that India's Digital Public Infrastructure has evolved through mutually reinforcing investments in connectivity, digital identity, and interoperable payment systems. This integrated development has strengthened the institutional foundations of India's digital economy while creating enabling conditions for broader financial inclusion, public service delivery, and digital innovation.

Digital Public Infrastructure and Macroeconomic Performance

India's real Gross Domestic Product increased from ₹113,694.93 billion in 2015–16 to ₹187,969.55 billion in 2024–25 despite the temporary contraction associated with the COVID-19 pandemic (Table 5 and Figure 5). Although multiple macroeconomic, demographic, and institutional factors shape economic growth, the sustained expansion of Digital Public Infrastructure occurred alongside continued real GDP growth throughout most of the study period.

The findings do not imply that Digital Public Infrastructure alone caused economic growth. Rather, they indicate that India's digital transformation progressed concurrently with broader macroeconomic expansion, consistent with theoretical perspectives that identify technological innovation, institutional efficiency, and reduced transaction costs as important contributors to long-run productivity growth (Lucas, 1988; Romer, 1990). The OECD (2024) and World Bank (2024) report similar conclusions, emphasising that integrated digital public systems create enabling conditions for inclusive economic development by strengthening governance, expanding financial inclusion, and improving market efficiency.

Table 5: *Gross Domestic Product at Constant Prices (2011-12 Series)*

<i>Year</i>	<i>GDP (₹ Billion)</i>
2015-16	113694.93
2016-17	123081.93
2017-18	131445.82
2018-19	139929.14
2019-20	145346.41
2020-21	136948.69
2021-22	150218.46
2022-23 (Final Estimates)	161649.13
2023-24 (First Revised Estimates)	176505.91
2024-25 (Provisional Estimates)	187969.55

Source: Ministry of Statistics and Programme Implementation (MOSPI), Government of India

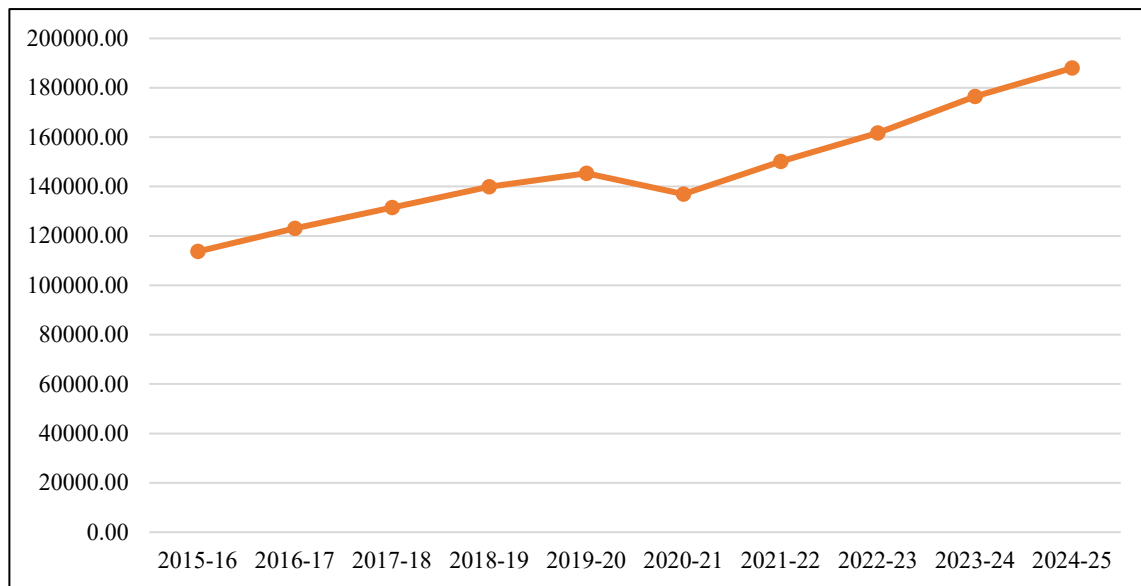


Figure 5: *Growth of GDP during the Study Period*

Comparative Growth Performance

The descriptive statistics (Table 6) reveal substantial variation in the pace of expansion across the selected indicators. UPI transaction value recorded the highest variability, reflecting its exceptionally rapid diffusion during the study period. Aadhaar authentication and the RBI Digital Payments Index also exhibited substantial growth, whereas Internet subscriptions expanded more steadily. In contrast, GDP displayed relatively low variability, consistent with the gradual nature of aggregate macroeconomic growth.

Table 6: *Descriptive Statistics of the Study Variables*

<i>Variable</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Coefficient of Variation</i>
Internet Subscribers (Million)	709.37	224.50	0.32
Yes/No Aadhaar Authentication Transactions (Million)	12408.09	7466.11	0.60
UPI Transaction Value (₹ Billion)	8553.34	9147.50	1.07
RBI Digital Payments Index	301.94	141.86	0.47
GDP (₹ Billion)	146679.00	23214.03	0.16

Source: Author's computation based on secondary data.

Table 7: CAGR of Digital India Indicators and GDP

<i>Indicator</i>	<i>Initial Year</i>	<i>Final Year</i>	<i>CAGR (%)</i>
Internet Subscribers (Million)	342.65	969.10	10.96
Yes/No Aadhaar Authentication (Million)	1043.80	22379.40	35.87
UPI Transaction Value (₹ Billion)	24.25	24772.22	115.95
RBI Digital Payments Index	100	493.22	22.08
Real GDP (₹ Billion)	113694.93	187969.55	5.16

Source: Author's computation.

The CAGR analysis (Table 7) further highlights these differences. UPI transaction value recorded the highest average annual growth (115.95%), followed by Aadhaar authentication (35.87%), the RBI Digital Payments Index (22.08%), Internet subscribers (10.96%), and real GDP (5.16%). The substantially higher growth rates of the digital indicators are unsurprising because digital platforms often benefit from network effects, whereby adoption accelerates as the number of users and participating institutions increases. These findings reinforce the view that Digital Public Infrastructure represents one of the fastest-evolving components of India's contemporary development trajectory.

DISCUSSION

The findings suggest that India's Digital Public Infrastructure has evolved as an integrated institutional ecosystem rather than as a collection of independent digital technologies. The concurrent expansion of digital connectivity, Aadhaar authentication, interoperable payment systems, and the digital payments ecosystem indicates that these platforms reinforce one another through network effects that improve institutional efficiency, facilitate financial inclusion, reduce transaction costs, and expand access to digital markets and public services. This interpretation extends endogenous growth theory by illustrating how public digital infrastructure operationalises technological innovation through institutional mechanisms that enhance productivity and support broader economic participation. Accordingly, the developmental significance of India's Digital Public Infrastructure lies not solely in technological adoption but in its capacity to strengthen the institutional foundations of the digital economy.

The study also corroborates recent international evidence that Digital Public Infrastructure functions as a foundational public good that improves governance, enables innovation, and supports inclusive economic development (Clark et al., 2025; OECD, 2024; World Bank, 2024). In particular, the rapid expansion of UPI and Aadhaar demonstrates how interoperable public digital platforms can transform service delivery when supported by enabling regulation, institutional coordination, and widespread digital adoption. These observations align with recent empirical studies that highlight India's DPI ecosystem as an internationally significant model for digital transformation (Chopra et al., 2026; Kiran & Sailaja, 2025).

At the same time, the findings highlight that the long-term developmental impact of Digital Public Infrastructure depends not only on continued technological expansion but also on improvements in digital inclusion, cybersecurity, privacy protection, digital literacy, and institutional governance. As digital platforms become increasingly embedded within economic and social systems, strengthening public trust and ensuring equitable access will remain central to maximising their developmental benefits. Consequently, future policy should view Digital Public Infrastructure as a socio-technical ecosystem in which technological innovation, institutional quality, and human capabilities evolve together to support sustainable economic development.

POLICY IMPLICATIONS

The findings highlight that Digital Public Infrastructure should be viewed as a strategic public institution rather than merely a technological platform. Its long-term developmental impact depends on the coordinated evolution of digital infrastructure, institutional capacity, regulatory quality, and human capabilities. Consequently, policy priorities should extend beyond expanding digital technologies to strengthening the broader ecosystem within which they operate.

First, continued investment in high-quality broadband infrastructure remains essential for reducing persistent regional disparities in digital access and ensuring that citizens and businesses can participate effectively in the digital economy. Expanding reliable and affordable connectivity, particularly in rural and underserved areas, should remain a central policy objective.

Second, the rapid growth of interoperable digital payments underscores the importance of strengthening cybersecurity, fraud prevention, consumer protection, and operational resilience. As digital financial transactions become increasingly embedded in economic activity, maintaining public confidence will require robust cyber-risk management, effective grievance-redress mechanisms, and continuous improvements in digital financial literacy.

Third, the growing integration of Aadhaar-based authentication and data-driven public services necessitates strong legal and institutional safeguards for privacy, data governance, and accountability. Transparent regulatory frameworks and effective implementation of data protection measures will be critical for balancing innovation with the protection of individual rights and sustaining public trust in Digital Public Infrastructure.

Fourth, investments in physical and digital infrastructure should be complemented by policies that strengthen digital capabilities across society. Targeted initiatives for women, rural populations, older adults, micro, small and medium enterprises (MSMEs), and other digitally excluded groups can help narrow digital inequalities and broaden participation in the economic opportunities created by digital transformation.

Finally, the effectiveness of Digital Public Infrastructure depends on continuous institutional innovation. Strengthening inter-agency coordination, promoting open and interoperable digital standards, encouraging responsible private-sector participation, and establishing adaptive regulatory frameworks will enhance the resilience and scalability of India's digital ecosystem. Such a balanced policy approach—integrating technological innovation with sound institutions and inclusive governance—will maximise the long-term contribution of Digital Public Infrastructure to sustainable economic development.

CONCLUSION

This study examined the evolution of India's Digital Public Infrastructure (DPI) under the Digital India programme by analysing trends in Internet subscribers, Aadhaar authentication transactions, Unified Payments Interface (UPI) transaction value, the Reserve Bank of India Digital Payments Index (RBI-DPI), and Gross Domestic Product (GDP) using nationally representative secondary data. The findings show sustained expansion across all four dimensions of Digital Public Infrastructure, with interoperable digital payments growing particularly rapidly. Collectively, these trends indicate that India's digital transformation has

progressed through complementary investments in digital connectivity, trusted digital identity, interoperable payment systems, and digital governance.

The study contributes to the emerging literature by conceptualising Digital Public Infrastructure as an integrated institutional ecosystem that translates technological innovation into broader developmental outcomes. Rather than functioning as isolated technological initiatives, the complementary components of India's DPI reinforce one another by reducing transaction costs, strengthening institutional efficiency, expanding financial inclusion, and facilitating wider participation in the digital economy. This integrated perspective extends conventional analyses of digital transformation, which frequently examine individual technologies in isolation, and provides a more comprehensive understanding of how interoperable public digital systems support economic development.

Although the analysis does not establish causal relationships between Digital Public Infrastructure and economic growth, the concurrent expansion of India's core DPI indicators and real GDP aligns with theoretical and empirical evidence highlighting the importance of technological innovation, institutional quality, and digital inclusion in promoting long-term productivity and economic performance. The findings therefore suggest that Digital Public Infrastructure should be understood not simply as a technological investment but as a strategic public institution that can strengthen governance, improve market efficiency, and enable inclusive development.

India's experience offers valuable lessons for other emerging and developing economies seeking to modernise public administration and accelerate digital transformation. However, sustaining the long-term developmental benefits of Digital Public Infrastructure will require continued investment in digital connectivity, cybersecurity, privacy protection, data governance, digital literacy, and institutional capacity. Ensuring that these complementary foundations evolve alongside technological innovation will be essential for building an inclusive, resilient, and sustainable digital economy.

LIMITATIONS AND FUTURE RESEARCH

This study has several limitations to consider when interpreting its findings. First, the analysis is based on nationally aggregated secondary data and therefore does not capture regional, sectoral, or household-level variations in Digital Public Infrastructure adoption and utilisation. Second, the descriptive research design identifies temporal associations rather than

causal relationships between Digital Public Infrastructure and macroeconomic performance. Third, differences in data availability across indicators limited the application of advanced econometric techniques and the inclusion of additional explanatory variables.

Future research should extend this work by employing longer time-series datasets, state-level panel data, or cross-country comparative analyses to examine the causal effects of Digital Public Infrastructure on economic growth and inclusive development. The application of econometric techniques such as autoregressive distributed lag (ARDL), vector autoregression (VAR), vector error correction models (VECM), panel-data estimation, or structural equation modelling (SEM) would provide deeper insights into the dynamic relationships among digital transformation, institutional quality, financial inclusion, and economic performance. Further research should also investigate sector-specific impacts of Digital Public Infrastructure on productivity, entrepreneurship, healthcare, education, agriculture, labour markets, and public service delivery, while examining how digital literacy, regulatory quality, cybersecurity, and data governance shape the long-term sustainability of digital transformation.

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