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Digital Public Infrastructure, Fintech Governance, and Inclusive Market Transformation: Comparative Institutional Evidence from India's UPI and Brazil's Pix

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ABSTRACT

This article examines how digital public infrastructure reshapes fintech governance, business systems, market inclusion, and sustainable socio-economic development in emerging digital economies. Using a comparative institutional case study of India's Unified Payments Interface and Brazil's Pix, the study argues that instant-payment systems are not merely technological innovations but institutional infrastructures that reorganize market participation, financial intermediation, state capacity, consumer trust, and business formalization. India and Brazil are selected because both have built large-scale, interoperable, low-cost payment infrastructures, yet their governance models differ substantially. India's UPI is embedded in a layered digital public infrastructure architecture involving digital identity, bank account expansion, mobile connectivity, and public-private payment applications. Brazil's Pix is centrally operated and regulated by the Central Bank of Brazil as a payment infrastructure designed to increase competition, reduce transaction costs, and expand inclusion. The comparison shows that digital financial transformation generates inclusive economic value when interoperability, public governance, private innovation, regulatory trust, and user protection are institutionally aligned. However, both cases also reveal risks of platform concentration, fraud, exclusion through digital divides, data governance weaknesses, and uneven business capability diffusion. The article contributes to international business, economic governance, fintech, and development policy literature by developing theoretical propositions on institutional interoperability, market trust, inclusive

fintech ecosystems, and sustainable digital development.

Keywords: digital public infrastructure; fintech governance; financial inclusion; UPI; Pix; India; Brazil; instant payments; institutional transformation; sustainable development

INTRODUCTION

Digital public infrastructure has become one of the most consequential institutional innovations in contemporary economic governance. Across advanced and emerging economies, digital identity systems, interoperable payment platforms, data-sharing rails, public registries, and real-time settlement infrastructures increasingly determine how citizens access services, how firms transact, how governments deliver welfare, and how markets generate trust. This transformation is not reducible to the diffusion of financial technology firms or mobile applications. It represents a deeper reconfiguration of the institutional foundations of market exchange. In economies where informality, cash dependence, fragmented banking access, high transaction costs, and uneven state capacity constrain development, digital public infrastructure can reduce frictions and expand participation. Yet it can also reproduce exclusion if connectivity gaps, digital literacy deficits, cybersecurity failures, and platform concentration are not governed effectively.

The global relevance of this issue has intensified because digitalization now sits at the intersection of business competitiveness, financial governance, social protection, public-sector modernization, and sustainable development. The World Bank defines digital public infrastructure as shared digital systems that support public and private services through foundational building blocks such as identity, payments, and data exchange; it emphasizes that DPI can improve government-to-person payments, financial inclusion, agricultural markets, health systems, and climate resilience, but also requires safeguards for data protection, cybersecurity, inclusion, and accountability (World Bank, 2025). This framing is significant because it shifts the analytical focus from isolated fintech innovation to infrastructure-mediated development. Similarly, UNCTAD argues that digitalization must be governed as an inclusive and environmentally sustainable process because digital technologies depend on energy, raw materials, data centres, devices, and e-waste systems; digital transformation therefore requires sustainability-oriented governance rather than purely expansionary digital adoption (UNCTAD, 2024).

India and Brazil provide analytically powerful comparative cases. Both are large emerging economies with substantial internal heterogeneity, high informality, regional inequality, deep social policy challenges, and rapidly expanding digital markets. Both have built real-time payment infrastructures that are internationally recognized for scale and inclusiveness. India's Unified Payments Interface, launched in 2016 by the National Payments Corporation of India under the regulatory oversight of the Reserve Bank of India, has become the backbone of India's retail digital payments ecosystem. Official Indian government data report that UPI annual transaction volume expanded from 2 crore transactions in FY2016–17 to more than 24,162 crore transactions in FY2025–26, while annual value increased to approximately ₹314 lakh crore; by March 2026, 703 banks were live on UPI (Ministry of Finance, Government of India, 2026).

Brazil's Pix, launched by the Central Bank of Brazil in November 2020, is similarly transformative. The IMF describes Pix as an electronic payment scheme created to reduce reliance on cash, improve payment efficiency, strengthen competition, and widen inclusion (IMF, 2023). The Central Bank of Brazil's Instant Payments System annual report shows that Pix interbank settlements reached 5.71 billion transactions in December 2024, while total transaction value settled through the system reached R$22.12 trillion in 2024, bringing cumulative value since launch to more than R$50.72 trillion (Banco Central do Brasil, 2025).

The comparison is theoretically important because India and Brazil have achieved similar digital-payment expansion through different institutional configurations. India's UPI is embedded within a broader digital public infrastructure stack involving Jan Dhan bank accounts, Aadhaar-based identity infrastructure, mobile connectivity, public-sector payment rails, and private-sector payment applications. Its governance model combines state-enabled infrastructure, bank participation, private app competition, and interoperability across payment service providers. India's January 2026 UPI performance—21.70 billion transactions worth over ₹28.33 lakh crore, with 691 banks live—demonstrates the scale of this institutional architecture (Government of India, 2026).

Brazil's Pix, by contrast, is more directly central-bank designed, regulated, and operated. The IMF identifies several design features behind Pix's success: near-instant settlement, low transaction costs, mandatory participation by large banks, early technical standards, public consultation, and the dual role of the Central Bank of Brazil as infrastructure provider and regulator (IMF, 2023). This model enabled rapid adoption while preventing dominant private platforms from extracting excessive fees or fragmenting market access. However, because the central bank is both regulator and infrastructure operator, Pix also raises debates about the boundary between public infrastructure, private competition, and state market-shaping authority.

The academic and policy problem addressed by this study is that fintech scholarship often treats digital payments as either consumer technology, financial innovation, or banking-sector modernization. Such perspectives are insufficient for explaining the broader political economy of digital public infrastructure. Instant payment systems influence transaction costs, merchant formalization, tax transparency, credit data generation, welfare delivery, competition between banks and fintech firms, platform market power, and household resilience. They also shape business systems by changing how microenterprises receive payments, how digital merchants interact with customers, how lenders assess cash flows, and how governments monitor economic activity. In this sense, digital payment infrastructures are institutional devices that restructure both market participation and state capacity.

Existing literature provides important but incomplete foundations. North (1990) explains that institutions reduce uncertainty and structure economic incentives, yet his framework requires extension to digital infrastructures that shape trust through code, standards, settlement rules, and data governance. Williamson (1985) emphasizes transaction-cost economizing, which is directly relevant to instant payments, but transaction-cost theory alone does not explain how public infrastructures produce inclusion and market

contestability. Schumpeter's theory of innovation highlights creative destruction, but UPI and Pix reveal a different dynamic: public infrastructure can enable private innovation without allowing closed proprietary networks to dominate market access. Platform-economy scholars emphasize network effects and data-driven market power (Cusumano et al., 2019; Kenney & Zysman, 2020), but India and Brazil show that interoperability can transform network effects from private monopoly assets into public economic capabilities.

Development finance literature similarly requires refinement. Beck, Demirgüç-Kunt, and Levine (2007) demonstrate the growth and poverty-reduction role of financial development, while Jack and Suri (2014) show that mobile money can improve household risk-sharing. More recent work on digital financial inclusion argues that mobile payments, digital credit, and fintech ecosystems can reduce access barriers but may also increase over-indebtedness, exclusion, surveillance, or fraud when regulation is weak (Arner et al., 2020; Frost, 2020; Ozili, 2020). The World Bank's Global Findex evidence for India illustrates this duality: account ownership reached 78% of adults in 2021 and India had no gender gap in account ownership, yet only 35% of adults used accounts for digital payments, while 35% of accounts were inactive (World Bank, 2022). This means that access does not automatically become meaningful financial use; institutional design must convert ownership into trust, capability, and repeated economic participation.

The research gap is therefore sixfold. First, there is a theoretical gap in explaining digital public infrastructure as an institutional market-making mechanism rather than merely a fintech tool. Second, there is an empirical gap in comparative evidence on how instant-payment systems reshape business systems in large emerging economies. Third, there is a comparative institutional gap in understanding why India's layered public-private model and Brazil's central-bank-operated model produce both convergent inclusion outcomes and divergent governance risks. Fourth, there is a business implementation gap in explaining how digital payments affect MSMEs, merchants, platform firms, banks, fintech start-ups, and informal enterprises. Fifth, there is a policy coordination gap because digital payments intersect with banking regulation, competition policy, consumer protection, cyber governance, fiscal capacity, and welfare delivery. Sixth, there is a sustainability gap because digital finance is often discussed as inclusion-enhancing without sufficient attention to data-centre energy demand, device dependence, digital waste, and the need for circular digital economy principles.

This article's novelty lies in treating UPI and Pix as comparative business-system infrastructures rather than as isolated payment innovations. It argues that fintech-led development depends on the institutional sequence connecting public infrastructure, market governance, business adoption, economic performance, and sustainable socio-economic outcomes. The article develops the following causal framework: institutional interoperability → market trust → fintech and business-system innovation → inclusive economic performance → sustainable socio-economic development. This framework explains why digital payment systems can expand inclusion when they reduce transaction costs and support open access, but may also generate new governance risks if market concentration, fraud, digital exclusion, and data asymmetry remain unresolved.

The research objective is to explain how India's UPI and Brazil's Pix demonstrate different institutional pathways through which digital public infrastructure transforms fintech governance, business systems, market inclusion, economic performance, and sustainable socio-economic development.

METHODOLOGY

This study uses a comparative institutional business systems methodology combining comparative economic analysis, digital economy governance analysis, and political economy interpretation. India and Brazil are selected through a most-different-with-convergent-outcomes logic: they differ in financial-system structure, regulatory architecture, public-sector organization, political economy, social inequality, and digital governance history, yet both have achieved rapid mass adoption of interoperable real-time payment systems. This allows the study to examine whether similar inclusion-oriented outcomes emerge from distinct institutional mechanisms. The theoretical-methodological alignment rests on institutional economics, comparative business systems, platform governance, and development finance theory. Institutions are treated as rule systems that structure incentives, allocate authority, reduce uncertainty, and shape market exchange; business systems are treated as embedded networks of firms, banks, fintech companies, merchants, regulators, and users; digital public infrastructure is treated as a foundational institutional architecture that enables public and private actors to transact, innovate, and govern at scale. The core comparative variables are interoperability, regulatory authority, public-private coordination, bank and fintech participation, transaction-cost reduction, business adoption, consumer protection, inclusion outcomes, competition effects, data governance, cyber risk, sustainability implications, and socio-economic resilience.

The empirical analysis is based on triangulated secondary evidence from official statistical, regulatory, institutional, and academic sources. The study uses data from the Reserve Bank of India, National Payments Corporation of India, Government of India, Central Bank of Brazil, IMF Article IV and selected-issues reports, World Bank Global Findex and digital public infrastructure publications, UNCTAD digital economy reports, BIS and peer-reviewed fintech literature, and comparative business and institutional theory. The analysis applies structured focused comparison, cross-case institutional mapping, and mechanism-based interpretation. Validation is pursued through source triangulation across government, multilateral, central-bank, and scholarly materials; analytical reliability is strengthened by distinguishing documented evidence from institutional inference. No interview data are used, and no respondent claims are fabricated. Ethical considerations concern responsible use of public data, avoidance of unsupported policy claims, and recognition that digital systems can generate exclusion, surveillance, fraud, and market concentration. The main limitation is that the study does not estimate econometric treatment effects; its contribution is explanatory and theory-building, appropriate for identifying causal institutional mechanisms linking digital infrastructure, business systems, and sustainable development.

Findings and Discussion

1. Institutional Design and Market Architecture: Layered Interoperability versus Central-Bank Platform

Governance

The first major finding is that India and Brazil demonstrate two distinct institutional pathways to digital payment inclusion. India's UPI operates as a layered interoperability model. The system's strength lies in the combination of public digital rails, bank account expansion, identity infrastructure, private app innovation, and real-time settlement across participating banks. UPI allows users to send and receive payments across different banks and applications, thereby reducing the fragmentation that normally limits network-based payment systems. The IMF emphasizes that interoperability was central to India's digital-payment acceleration because users could transact across apps and banks rather than being locked into closed-loop systems; more than 200 apps and most banks entered the UPI market, although transaction initiation later became concentrated among three dominant apps (Copestake & Kirti, 2025).

Brazil's Pix represents a central-bank platform governance model. Rather than relying primarily on privately governed payment networks, Pix was designed and governed by the Central Bank of Brazil as a public payment infrastructure. The system requires large institutions to participate, provides low-cost or free transfers for individuals, and establishes common technical and procedural standards. The IMF reports that Pix payments settle in about three seconds on average, compared with two days for debit cards and twenty-eight days for credit cards, while transaction costs for firms are substantially lower than debit and credit card costs (IMF, 2023).

The comparison reveals that interoperability is not a technical feature alone; it is an institutional settlement among banks, fintech firms, regulators, users, and merchants. In India, interoperability creates open competition among apps and banks, but the growth of dominant front-end providers shows that open rails do not automatically prevent platform concentration. In Brazil, central-bank operation prevents fragmentation and fee extraction, but it raises questions about how far public authorities should shape market competition. This reflects a central tension in digital economy governance: infrastructure must be open enough to enable innovation, but governed enough to prevent exclusion, rent extraction, and systemic risk.

Institutional theory helps explain this divergence. North (1990) argues that institutions reduce uncertainty; in instant payments, uncertainty is reduced through settlement finality, authentication rules, technical standards, liquidity arrangements, dispute mechanisms, and regulatory oversight. Williamson's transaction-cost logic is also visible: UPI and Pix reduce search, bargaining, verification, and settlement costs in daily commerce. However, both cases extend conventional institutional economics because trust is partly encoded into digital architecture. Payment reliability, interoperability, and settlement speed become governance mechanisms.

For business systems, the implications are profound. Merchants can accept payments without costly card terminals. Microenterprises can build transaction histories. Consumers can shift from cash to traceable digital payments. Banks and fintech companies can innovate on top of shared infrastructure. Governments can deliver benefits more transparently. Yet the system-level outcome depends on institutional safeguards. India must manage front-end app concentration and digital literacy barriers. Brazil must manage fraud, cybersecurity, and the boundary between public infrastructure and private innovation. The evidence therefore indicates that inclusive fintech governance is neither purely market-led nor purely state-led; it is produced through institutionalized interoperability.

2. Financial Inclusion, Business Formalization, and MSME Transformation

The second finding is that digital payment infrastructure expands inclusion most effectively when it converts account access into repeated economic use. India's experience shows both progress and limits. The World Bank reported that 78% of Indian adults had an account in 2021 and that the gender gap in account ownership had been eliminated, but it also found that only 35% of adults used accounts for digital payments and that 35% of accounts were inactive (World Bank, 2022). UPI's subsequent expansion suggests that India's inclusion challenge has shifted from account opening to active usage, merchant acceptance, digital confidence, and data-enabled financial services.

UPI's scale indicates a profound transformation in transaction behaviour. Government data report 21.70 billion transactions in January 2026 worth more than ₹28.33 lakh crore, while FY2025–26 annual volume exceeded 24,161 crore transactions (Government of India, 2026). This scale matters because high-frequency, low-value digital payments are especially relevant for small merchants, informal workers, street vendors, transport operators, and service providers. The value of UPI lies not only in payment convenience but in the creation of digital transaction trails that can support credit assessment, inventory planning, tax visibility, and business integration.

Brazil's Pix similarly transforms inclusion through low-cost, real-time payments. Its rapid growth is notable because Brazil already had a sophisticated banking sector but also faced high banking concentration, informality, and unequal access to affordable payment services. Pix reduced reliance on cards, cash, and boleto-based payment instruments by making instant transfers widely available. The Central Bank of Brazil reported that interbank Pix settlements reached 5.71 billion transactions in December 2024 and R$22.12 trillion in 2024 value (Banco Central do Brasil, 2025). Because half of Pix transactions in December 2024 were below R$39 and 90% were below R$400, the system clearly serves everyday retail and household transactions rather than only high-value transfers.

The cross-case comparison shows that payment inclusion is not equivalent to financial inclusion. Payment inclusion provides the transaction layer, but financial inclusion requires savings, responsible credit, insurance, resilience, and consumer protection. India's UPI can support MSME credit through transaction data, but digital credit expansion can become predatory if underwriting, consent, and grievance systems are weak. Brazil's Pix can support merchants without credit cards and simplify recurring payments, but the same system can expose users to fraud and coercive transfers if security protocols do not evolve. Thus, digital payments create the possibility of inclusion, while governance determines whether inclusion becomes welfare-enhancing.

This finding aligns with development finance literature showing that transaction-cost reduction can improve household resilience and enterprise activity (Jack & Suri, 2014; Suri & Jack, 2016). However, the India–Brazil evidence adds an institutional dimension. Mobile money studies often focus on private telecom-led systems, while UPI and Pix show that public infrastructure can generate inclusion at national scale. Theoretically, this supports the view that markets are institutionally constructed rather than naturally inclusive. The state does not merely regulate fintech markets after they emerge; it can design the rails through which inclusive markets become possible.

For business policy, the implication is that governments should focus not only on adoption metrics but on

capability diffusion. MSMEs need digital onboarding, low-cost devices, grievance redress, cybersecurity awareness, accounting integration, and access to responsible credit. Banks and fintech firms need incentives to use transaction data ethically and competitively. Public authorities need to ensure that payment infrastructure does not become a surveillance mechanism or a rent-generating gateway for dominant platforms. Inclusive market transformation therefore requires moving from payment access to productive financial use.

3. Competition, Platform Power, and Fintech Ecosystem Development

The third finding is that open digital payment infrastructures can increase competition but do not automatically eliminate market power. India's UPI is highly interoperable, yet the IMF warns that more than 95% of UPI transactions are initiated through only three apps, indicating that open rails can coexist with concentrated front-end control (Copestake & Kirti, 2025). This is a critical business-system insight: infrastructure openness reduces entry barriers at the protocol level, but platform competition can reappear at the application, interface, data, and customer-relationship layers.

Brazil's Pix reduces market power differently. Because the Central Bank of Brazil operates the infrastructure and mandates participation by large banks, it prevents incumbent institutions from blocking interoperability. The IMF notes that mandatory participation by big banks helped overcome interoperability challenges from the start, while the central bank's role as infrastructure provider and regulator prevented large technology firms from quickly capturing market share and extracting fees (IMF, 2023).

The contrast reveals two models of fintech competition. India's model promotes innovation through a contestable app ecosystem built on shared rails. Brazil's model promotes competition through public infrastructure that disciplines incumbents and reduces transaction costs. India's risk is private platform dominance at the user-interface layer; Brazil's risk is excessive dependence on central-bank governance and slower private differentiation in some payment services. Both cases challenge simplistic narratives that fintech innovation is inherently decentralizing. Digital markets often display network effects, economies of scale, data advantages, and behavioural lock-in (Cusumano et al., 2019; Kenney & Zysman, 2020).

The business implications are substantial. Banks in both countries must compete not only on deposits or lending but on digital interfaces, reliability, merchant analytics, embedded finance, fraud prevention, and ecosystem partnerships. Fintech firms must innovate on services rather than exclusive network access. Merchants benefit from lower acceptance costs but may become dependent on dominant apps, QR ecosystems, or payment-data intermediaries. Consumers gain convenience but face risks related to fraud, privacy, and behavioural nudging.

From a theoretical perspective, the comparison extends platform governance scholarship. Platform power is usually associated with private firms controlling digital ecosystems. UPI and Pix show that public infrastructures can create "platforms without monopoly ownership," but they cannot abolish all forms of power. Power shifts from settlement networks to app interfaces, data analytics, fraud controls, consumer trust, and regulatory agenda-setting. Therefore, competition policy must evolve from price and market-share analysis toward infrastructural governance. Regulators need to monitor app concentration, switching costs, data portability, merchant fees, algorithmic credit

scoring, and consumer redress.

The development implication is that fintech competition should be evaluated by inclusive outcomes. More fintech firms do not automatically mean better inclusion if users cannot compare services, if rural merchants lack digital capacity, or if fraud reduces trust. Likewise, a public infrastructure is not automatically equitable if vulnerable groups lack mobile access, digital literacy, or legal protection. The appropriate policy benchmark is not the number of apps or transaction volume alone, but whether digital finance expands fair, affordable, secure, and productive market participation.

4. State Capacity, Welfare Delivery, and Economic Governance

The fourth finding is that real-time payment infrastructure strengthens economic governance by improving the state's ability to deliver transfers, monitor payments, reduce leakages, and coordinate welfare systems. India's digital public infrastructure is closely tied to public financial management and direct benefit transfer systems. The Government of India states that the Public Financial Management System enabled end-to-end monitoring of government funds and electronic payments, and that direct benefit transfer reforms helped remove duplicate and fake beneficiaries, with cumulative DBT transfers exceeding ₹49.09 lakh crore by January 2026 (Government of India, 2026).

This matters because welfare delivery is one of the central institutional tests of digital transformation. If digital systems reduce leakage, speed up payments, and improve targeting, they can strengthen public trust and social protection. However, digital welfare systems also create risks: exclusion due to authentication failure, lack of connectivity, documentation gaps, or grievance-access barriers. India's experience therefore shows that public digital infrastructure can enhance state capacity, but it must be supported by offline alternatives, transparent grievance mechanisms, and rights-based governance.

Brazil's Pix also has state-capacity implications, although its initial design emphasized retail payment efficiency and competition rather than welfare-state integration to the same degree as India's DPI stack. Pix enables government, business, and household transactions through a single interoperable system. Its integration into tax payments, public transfers, and service payments increases the visibility and speed of economic flows. In institutional terms, Pix allows the state to govern the circulation of money more effectively without directly replacing private financial institutions.

The comparison reveals different sequences of digital state-building. India's sequence begins with account inclusion and identity-linked welfare delivery, then scales interoperable payments and digital commerce. Brazil's sequence begins with central-bank payment modernization and then expands into broader public and private use cases. Both sequences show that payment infrastructure can become a fiscal, regulatory, and developmental tool. Yet neither sequence is risk-free. India must prevent welfare digitalization from excluding citizens who lack digital capability. Brazil must ensure that public payment infrastructure does not become over-centralized or vulnerable to systemic cyber risk.

This finding connects to Mazzucato's (2021) argument that the state can shape markets rather than merely

fix failures. UPI and Pix are examples of market-shaping public infrastructure: they define the conditions under which private actors compete, transact, and innovate. They also support fiscal capacity by increasing traceability and lowering the administrative costs of payment flows. However, the state's market-shaping role must be accountable. Public digital infrastructure requires democratic oversight, transparent governance, data minimization, competition safeguards, and independent auditability.

For economic performance, the implication is that payment infrastructure can contribute to productivity by reducing frictions in commerce, public finance, and business operations. Faster payments improve cash-flow management for small firms. Lower payment costs increase merchant margins. Digital records can support formal credit. Real-time settlement reduces uncertainty. Yet productivity effects depend on complementary conditions: business skills, access to credit, digital accounting, consumer trust, and regulatory stability. Digital payments are therefore enabling infrastructure, not a complete development strategy.

5. Sustainability, Resilience, and Responsible Digital Development

The fifth finding is that digital financial infrastructure contributes to sustainable development only when inclusion, resilience, and environmental responsibility are jointly governed. UPI and Pix can support sustainability indirectly by reducing cash-handling costs, improving welfare delivery, enabling digital credit for small businesses, supporting women's economic participation, formalizing transactions, and improving household resilience. Yet digital systems also depend on smartphones, electricity, cloud infrastructure, telecommunications networks, cybersecurity systems, and data centres. UNCTAD warns that digital devices, data centres, and ICT networks account for an estimated 6% to 12% of global electricity use and that digitalization creates environmental pressures through raw-material extraction, production, and waste (UNCTAD, 2024).

This is important because fintech is often presented as environmentally neutral. In reality, digital finance has a material footprint. Expanding digital payments requires devices, connectivity, servers, software systems, and energy. The sustainability question is therefore not whether digital payments are "green" by default, but whether digital financial systems are governed within a circular and responsible digital economy. This includes extending device lifecycles, reducing e-waste, improving energy efficiency, designing low-bandwidth systems, protecting consumers from fraud, and ensuring accessibility for low-income users.

India's sustainability challenge is inclusion at scale. UPI's massive reach can support low-cost commerce and welfare delivery, but persistent gaps in digital confidence, rural connectivity, women's mobile ownership, and account inactivity can weaken equitable outcomes. The World Bank reported that only 66% of Indian adults had their own mobile phone in 2021, with a substantial gender gap between men and women (World Bank, 2022). This indicates that digital payment growth must be accompanied by gender-sensitive connectivity, digital literacy, and consumer-protection policies.

Brazil's sustainability challenge is resilience and trust. Pix's rapid adoption creates systemic importance. As more households, merchants, and public services depend on Pix, system availability, fraud prevention, liquidity management, and cyber resilience become sustainability issues in the broad institutional sense. The Central Bank of

Brazil's SPI report emphasizes system availability requirements and performance monitoring, reflecting the fact that instant-payment infrastructure has become critical financial infrastructure (Banco Central do Brasil, 2025).

The comparison suggests that sustainable digital development requires three forms of resilience. First, financial resilience: households and firms must be able to transact, save, borrow, and receive transfers securely. Second, institutional resilience: regulators and operators must manage fraud, liquidity, cyber risk, and competition. Third, environmental resilience: digital infrastructures must reduce their material and energy footprint over time. UPI and Pix show that fintech governance must move from inclusion-first narratives toward responsible digital development frameworks.

This finding contributes to sustainability transition literature by showing that socio-technical transitions occur not only in energy, transport, and manufacturing but also in financial infrastructures. Payment systems shape consumption, business models, tax systems, credit markets, and welfare delivery. They therefore influence development pathways. Sustainable finance scholarship should pay greater attention to payment rails because they are the transactional foundation through which green subsidies, climate insurance, digital carbon markets, small-firm finance, and social transfers may operate.

Table 1. Analytical Matrix of Comparative Business and Economic Development

Variable	Case 1: India's UPI	Case 2: Brazil's Pix	Empirical Evidence	Analytical Interpretation
Institutional architecture	Layered digital public infrastructure combining bank accounts, digital identity, mobile connectivity, public payment rails, and private apps	Central-bank-designed and operated instant-payment infrastructure integrated into the national payment system	UPI had 703 banks live by March 2026; Pix had 863 SPI participants by December 2024	India emphasizes ecosystem layering; Brazil emphasizes central-bank platform governance
Governance logic	Public infrastructure with private app competition and bank participation	Public infrastructure with mandatory large-bank participation and central-bank regulatory authority	IMF highlights interoperability in UPI; IMF identifies Pix's mandatory participation and public infrastructure	Both systems reduce fragmentation, but India faces app concentration while Brazil faces state-platform

			role	boundary questions
Transaction scale	FY2025–26 UPI volume exceeded 24,161 crore transactions and ₹314 lakh crore in value	Pix settled R$22.12 trillion in 2024 through SPI and reached 5.71 billion interbank transactions in December 2024	Official Indian and Brazilian central-bank data document large-scale adoption	Both systems have become systemically important infrastructures for everyday commerce
Business-system impact	Supports MSME digital payments, merchant QR adoption, fintech services, digital credit potential, and welfare-linked transfers	Reduces merchant payment costs, challenges card networks, enables recurring payments, and broadens digital transaction access	Pix transaction costs for firms are reported below debit and credit card costs; UPI dominates Indian retail payment volumes	Payment rails reshape market participation and alter bank-fintech-merchant relationships
Competition effects	Open rails support entry, but front-end app use is concentrated among leading providers	Central-bank infrastructure disciplines incumbents and reduces network fragmentation	IMF notes more than 95% of UPI transactions are initiated through only three apps; Pix mandates participation by major institutions	Open infrastructure must be combined with platform competition monitoring
Inclusion mechanism	Converts bank account ownership into active digital use through interoperable payments	Reduces cash dependence and payment costs through instant, low-cost transfers	World Bank reports 78% account ownership in India in 2021 but high account inactivity; Pix records high low-value transaction use	Inclusion requires active use, trust, literacy, and consumer protection
State-capacity mechanism	Direct benefit transfers, public financial	Central-bank payment modernization,	India reports large cumulative DBT transfers;	Digital payments strengthen fiscal and administrativ

	management, welfare transparency, and payment traceability	tax/payment integration, and real-time national settlement	Brazil's SPI operates as RTGS infrastructure for Pix	e capacity when rights safeguards exist
Sustainability implication	Potential to reduce exclusion and strengthen social transfers, but constrained by gendered mobile access and digital literacy gaps	Potential to strengthen transaction resilience and reduce payment costs, but requires cyber and operational resilience	UNCTAD warns digital infrastructure has material and energy footprints	Sustainable digital finance requires inclusion, cyber resilience, and circular digital economy principles
Developmental risk	Platform concentration, inactive accounts, cyber fraud, digital divide, and responsible credit concerns	Fraud, systemic dependence, central-bank role debate, and unequal digital capability	IMF and World Bank sources identify both benefits and implementation risks	Digital public infrastructure is developmental only when governance keeps pace with scale

The table shows that India and Brazil have not simply digitized payments; they have reorganized the institutional foundations of market exchange. India's UPI demonstrates how layered infrastructure can transform transaction behaviour when public rails are combined with private innovation and mass bank participation. Brazil's Pix demonstrates how a central bank can directly design a payment infrastructure that reduces fees, mandates interoperability, and disciplines incumbent market power. The analytical interpretation is that digital public infrastructure produces inclusive economic value through institutional complementarity. Payment rails must complement identity systems, banking access, consumer protection, cybersecurity, merchant capability, competition policy, and sustainability governance.

The comparison also shows that scale creates governance obligations. Once payment infrastructure becomes embedded in everyday commerce, it becomes a critical public utility even if accessed through private apps. This means that regulatory frameworks must address systemic risk, operational continuity, data rights, fraud liability, and market concentration. India's challenge is to preserve the open character of UPI while preventing front-end platform dominance and ensuring meaningful use among underserved groups. Brazil's challenge is to preserve Pix's inclusive and competitive advantages while managing fraud, innovation boundaries, and central-bank operational responsibilities.

Theoretical Propositions

Proposition 1: Institutional interoperability is a precondition for inclusive fintech-led market transformation.

UPI and Pix show that digital payments scale when users, banks, fintech firms, merchants, and public agencies can transact across institutional boundaries. Interoperability transforms fragmented networks into shared economic infrastructure. However, interoperability must be governed, because open technical rails can still produce concentrated platform power at the application layer.

Proposition 2: Public digital infrastructure strengthens business-system competitiveness when it reduces transaction costs while enabling private innovation.

Both cases demonstrate that public infrastructure can support private-sector dynamism without ceding market access to closed proprietary systems. The competitive advantage of DPI lies in lowering entry barriers, reducing payment frictions, and allowing firms to innovate on services rather than on exclusive network control.

Proposition 3: Financial inclusion becomes developmentally meaningful only when access is converted into active, secure, and productive use.

Account ownership and payment adoption are necessary but insufficient. Inclusive development requires digital literacy, consumer protection, responsible credit, grievance mechanisms, gender-sensitive access, and business capability building. India's inactive-account challenge and Brazil's fraud-risk concerns illustrate why usage quality matters as much as adoption scale.

Proposition 4: Digital payment infrastructures become instruments of economic governance when they enhance fiscal capacity, welfare delivery, market transparency, and institutional trust.

UPI and Pix show that payment systems can improve public expenditure monitoring, transfer delivery, and transaction visibility. Yet these benefits require accountable governance to prevent exclusion, surveillance, or misuse of data.

Proposition 5: Sustainable digital development requires integrating fintech governance with cyber resilience, environmental responsibility, and inclusive socio-economic policy.

Digital finance is not automatically sustainable. Its developmental contribution depends on whether payment systems are secure, energy-conscious, accessible, rights-protective, and aligned with broader social and environmental goals.

CONCLUSION

This article examined how India's UPI and Brazil's Pix demonstrate different institutional pathways through which digital public infrastructure transforms fintech governance, business systems, market inclusion, economic performance, and sustainable socio-economic development. The central answer to the research objective is that instant-payment infrastructures generate developmental value not because they are technologically advanced, but because they institutionalize interoperability, reduce transaction costs, expand market participation, and create shared foundations for public and private innovation.

The main finding is that India and Brazil have built distinct but functionally comparable infrastructures. India's UPI is a layered public-private ecosystem that connects digital identity, bank accounts, mobile connectivity, banks, fintech applications, and merchant networks. Brazil's Pix is a central-bank-led payment infrastructure that mandates participation, reduces costs, and establishes common standards. Both models demonstrate that inclusive fintech transformation is institutionally constructed. Markets become more inclusive when the state provides open rails, regulates participation, protects users, and allows firms to innovate on top of shared infrastructure.

The theoretical contribution is threefold. First, the article extends institutional economics by showing that digital code, interoperability standards, settlement rules, and platform governance now function as economic institutions. Second, it contributes to business systems theory by demonstrating that fintech infrastructure reshapes the relationships among banks, fintech firms, merchants, consumers, and states. Third, it contributes to sustainable development scholarship by arguing that digital finance must be evaluated through inclusion, resilience, competition, data governance, and environmental responsibility.

The empirical contribution lies in the structured comparison of two large emerging economies that have become global reference points for instant payments. India illustrates the power and risks of layered digital public infrastructure: scale, private innovation, and welfare integration coexist with app concentration, digital divides, and inactive-account legacies. Brazil illustrates the power and risks of central-bank platform governance: rapid adoption, low costs, and competitive discipline coexist with fraud risks, systemic dependence, and debates about the public role in market infrastructure.

For business practice, the implications are significant. Firms should understand payment infrastructure as a strategic environment that affects customer acquisition, merchant relationships, credit scoring, cash-flow management, platform competition, and trust. For public policy, the article suggests that governments should prioritize interoperability, open standards, consumer protection, responsible data use, cybersecurity, and competition monitoring. For sustainable development, the article stresses that digital payment systems must be linked to inclusive finance, MSME upgrading, gender-sensitive access, welfare-state capacity, and circular digital economy principles.

The study has limitations. It relies on secondary data and institutional interpretation rather than firm-level interviews or econometric estimation. Future research should test the proposed mechanisms using merchant-level data, transaction-pattern analysis, gender-disaggregated inclusion metrics, cyber-fraud datasets, and comparative studies involving additional systems such as Singapore's PayNow, Thailand's PromptPay, Mexico's CoDi, and regional cross-border payment initiatives. Further research should also examine how instant-payment infrastructures influence credit markets, tax formalization, platform labour, ESG finance, and climate-resilient social protection.

The broader conclusion is that digital public infrastructure has become a new frontier of economic governance. UPI and Pix show that the future of fintech is not merely private innovation but institutionally governed interoperability. The developmental promise of digital finance will depend on whether countries

can design infrastructures that are open but secure, innovative but accountable, scalable but inclusive, and digital but sustainable.

REFERENCES

Acemoglu, D., & Restrepo, P. (2020). Robots and jobs: Evidence from US labor markets. Journal of Political Economy, 128(6), 2188–2244.

Arner, D. W., Barberis, J., & Buckley, R. P. (2020). The evolution of fintech: A new post-crisis paradigm? Georgetown Journal of International Law, 47(4), 1271–1319.

Banco Central do Brasil. (2025). Instant Payments System Annual Report 2024. Banco Central do Brasil.

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2007). Finance, inequality and the poor. Journal of Economic Growth, 12, 27–49.

Copestake, A., & Kirti, D. (2025). India's frictionless payments. Finance & Development. International Monetary Fund.

Cusumano, M. A., Gawer, A., & Yoffie, D. B. (2019). The business of platforms: Strategy in the age of digital competition, innovation, and power. Harper Business.

Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2022). The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19. World Bank.

Frost, J. (2020). The economic forces driving fintech adoption across countries. BIS Working Papers.

Gomber, P., Koch, J. A., & Siering, M. (2017). Digital finance and fintech: Current research and future research directions. Journal of Business Economics, 87, 537–580.

Government of India. (2026). India's digital public infrastructure. Press Information Bureau.

International Monetary Fund. (2023). Brazil: Selected issues—Pix: Brazil's successful instant payment system. IMF Country Report.

International Monetary Fund. (2025a). Brazil: 2025 Article IV consultation. IMF.

International Monetary Fund. (2025b). India: 2025 Article IV consultation. IMF.

Jack, W., & Suri, T. (2014). Risk sharing and transaction costs: Evidence from Kenya's mobile money revolution. American Economic Review, 104(1), 183–223.

Kenney, M., & Zysman, J. (2020). The platform economy: Restructuring the space of capitalist accumulation. Cambridge Journal of Regions, Economy and Society, 13(1), 55–76.

Klapper, L., Singer, D., & Ansar, S. (2022). Global Findex Database 2021 country brief: India. World Bank.

Mazzucato, M. (2021). Mission economy: A moonshot guide to changing capitalism. Allen Lane.

Ministry of Finance, Government of India. (2026). UPI completes 10 glorious years: World's largest real-time payments platform. Press Information Bureau.

North, D. C. (1990). Institutions, institutional change and economic performance. Cambridge University Press.

Ozili, P. K. (2020). Financial inclusion and fintech during COVID-19 crisis: Policy solutions. The Digital

Transformation of Finance.

Philippon, T. (2019). On fintech and financial inclusion. NBER Working Paper Series.

Suri, T., & Jack, W. (2016). The long-run poverty and gender impacts of mobile money. Science, 354(6317), 1288–1292.

UNCTAD. (2024). Digital Economy Report 2024: Shaping an environmentally sustainable and inclusive digital future. United Nations Trade and Development.

Williamson, O. E. (1985). The economic institutions of capitalism. Free Press.

World Bank. (2025). Digital public infrastructure and development: A World Bank Group approach. World Bank.

Zetzsche, D. A., Arner, D. W., Buckley, R. P., & Weber, R. H. (2020). The future of data-driven finance and regtech: Lessons from EU big bang II. Stanford Journal of Blockchain Law & Policy, 3(2), 1–45.

