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Who Innovates on Public Digital Rails? Lessons from India's UPI

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Abstract

India's Unified Payments Interface (UPI) is the world's largest real-time payment system and a notable example of the use of digital public infrastructure for technology governance. This approach is often summed up by the formula "public rails, private innovation," where the public sector supplies a thin layer of protocols on which the private sector innovates. We argue that, in the UPI ecosystem, a different formula better captures the reality of innovation: "public rails, public innovation, private service delivery." Within this context, the National Payments Corporation of India, beyond its role as a system operator and scheme manager, regularly releases features on its own rails, which the private sector then delivers to the public. While "public rails, public innovation, private service delivery" has been successful in the Indian context, bringing millions of Indians into the formal financial sector, it also surfaces important trade-offs between competition and inclusion goals.

Who Innovates on Public Digital Rails?

Lessons from India's UPI

Jeremy McKey, Felix Chen, and Mihir Kshirsagar[1]

1. Introduction

Since its launch in 2016, India's Unified Payments Interface (UPI) has become the world's largest real-time payment system by volume,[2] with over half a billion transactions a day across an active user base of 400 million adults,[3] and providing a gateway for hundreds of millions of Indians into the formal financial sector. Notably, UPI was pioneered by the public sector, in contrast to the private actors that dominate the fintech space around the world, such as credit card networks in the United States, Alipay and WeChat Pay in China, and M-Pesa in Kenya.

UPI is a novel approach to digital public infrastructure (DPI), which argues that the state should treat digital infrastructure, including payment systems, like it treats physical infrastructure—as something that the public sector can provide to enable innovation by private actors and benefit society through competition.

Within this context, this paper attempts to address the following question: who innovates on UPI's digital public rails? Focusing on the payment system itself rather than adjacent sectors like credit, the evidence suggests that the public sector plays a comparable, if not greater, role than the private sector in innovation. Beyond maintaining the rails, the National Payments Corporation of India (NPCI)—the semi-public entity that operates UPI—has itself become an innovator, regularly updating its protocols while pushing out application-level features that directly compete with private alternatives.

The private sector story is more complicated. While PhonePe and Google Pay, which together handle 80% of UPI transactions,[4] also regularly push out new features, many are features already built by NPCI. In turn, NPCI occasionally incorporates innovations from the private sector into its own rail-level offerings, expanding the interoperable rail to embrace features that were previously part of the edge.

[1] The authors acknowledge the support of Princeton's Center for Global India (CGI) for funding this research. The idea for this paper emerged from a workshop on UPI and innovation that the authors co-organized with Artha Global and eGov Foundation in Bengaluru, India, in January 2025. Jeremy McKey also thanks the participants of the September 2026 Politics of Payments workshop at the Hamburger Institut für Sozialwissenschaft for their feedback. Kamya Chandra, David Eaves, Saranya Gopinath, Tarun Khanna, Krishnapriya VS, Giselle Labrador-Badia, CV Madhukar, Payal Malik, and David Porteous all generously reviewed earlier versions of this paper. All views and errors are those of the authors alone.

[2] Alexander Copestake et al., "Growing Retail Digital Payments," *Fintech Notes* 2025, no. 004 (2025): 1, https://doi.org/10.5089/9798229014250.063; ACI Worldwide, *It's Prime Time for Real-Time* (2024), https://www.aciworldwide.com/wp-content/uploads/2024/09/2024-Prime-Time-for-Real-Time-Report.pdf.

[3] PIB Delhi, "UPI Completes 10 Glorious Years, Emerges as World's Largest Real-Time Payments Platform, Anchoring India's Digital Economy," Ministry of Finance, April 30, 2026, https://www.pib.gov.in/www.pib.gov.in/Pressreleaseshare.aspx?PRID=2257087.

[4] NPCI, "Unified Payments Interface (UPI) Ecosystem Statistics," accessed October 16, 2026, https://www.npci.org.in/product/ecosystem-statistics/upi.

The emerging picture of innovation in the UPI ecosystem is one in which the public operator itself builds on the rail that it operates, while also expanding the rail to include features that private actors can easily incorporate into their own offerings. Accordingly, the DPI approach has been driven by the formula "public rails, private innovation."[5] However, the evidence supports a different formula rather than one where public rails lead to private innovation: "public rails, public innovation, private service delivery." In the case of UPI, this formula has proven to be successful. Our analysis pushes policymakers seeking to replicate UPI's success elsewhere in the world to focus on the precise mechanics of competition and innovation.

2. Defining Innovation

Innovation is fundamental to economies and societies. Governments enact policies that aim to facilitate innovation; private firms foster cultures of innovation; economists study how innovation contributes to economic growth and improved living standards. For the purposes of this paper, we seek to understand how innovations are emerging from different actors on top of India's public payment rail. But to begin our analysis, we need to address a thorny definitional issue confronted by policymakers, private actors, and scholars: what counts as innovation in the first place, and how do we measure it?

In a report first published in 1992 and revised many times since,[6] the OECD sought to provide a definition of innovation that can be used for statistical comparisons across member countries. The most recent version (2018) defines innovation as "a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)."[7]

While this definition raises numerous questions, it does offer a useful starting point for our analysis.[8]

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[5] The mantra "public rails, private innovation" is ubiquitous in discussions about DPI. In a 2024 speech, Nandan Nilekani, the visionary behind much of India's DPI architecture, described DPI as "a way of thinking about population scale infrastructure which allows you to combine public rails with private innovation." (Yogesh Hirdaramani, "Digital Public Infrastructure Will Be the next Bound of Connectivity – Global DPI Summit," GovInsider, October 9, 2024, https://govinsider.asia/intl-en/article/digital-public-infrastructure-will-be-the-next-bound-of-connectivity-global-dpi-summit)
A Harvard Business School case study, authored by Professor Tarun Khanna, similarly describes how India's approach to DPI builds "public rails on which private innovation had flourished transforming India in less than a decade." (Tarun Khanna et al., "India Stack: Digital Public Infrastructure for All," Harvard Business School, May 2024, https://www.hbs.edu/faculty/Pages/item.aspx?num=64379)
In his keynote address for the 2025 Global Fintech Fest in Mumbai, RBI Governor Sanjay Malhotra spoke of how "this synergy between public rails and private innovation, has been the bedrock of India's success in several domains, including digitalization of payments." (Sanjay Malhotra, "Driving Inclusive and Sustainable Growth through Digital Public Infrastructure and FinTech," Global Fintech Fest, Mumbai, October 8, 2025, https://www.bis.org/speeches/20251016-driving-inclusive-and-sustainable-growth-through-digital-public-infrastructure-and-fintech)

[6] OECD, *OECD Proposed Guidelines for Collecting and Interpreting Technological Innovation Data - Oslo Manual*, The Measurement of Scientific and Technological Activities (OECD, 1992), https://doi.org/10.1787/87954fc6-en.

[7] OECD and Eurostat, *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition*, The Measurement of Scientific, Technological and Innovation Activities (OECD Publishing, 2018), 60, https://doi.org/10.1787/9789264304604-en.

[8] For example: Who judges when a new product or process "differs significantly" from a previous version? Is a combination of different products and processes one innovation or multiple?

Ideas about innovation have evolved. Joseph Schumpeter, writing in the early 20th century, described innovation as "creative destruction": the process by which new technologies, products, and organizational forms displace existing ones.[9] By this view, innovation is inherently disruptive; it advances the economy by rendering the old obsolete. Clayton Christensen introduced a distinction between sustaining innovation and disruptive innovation.[10] He argued that much of what large firms do is sustaining innovation—incremental improvements to existing products that serve existing customers. Disruption, in Christensen's account, comes from small firms serving overlooked markets with cheaper, simpler products that gradually improve until they overtake incumbents.

These theories try to explain innovation in competitive product markets—semiconductors, automobiles, software—where firms compete to sell goods to consumers. Firms compete, experiment, and disrupt; the economy advances, either through rivalry and competition among firms or through their pursuit of monopoly profits. Either way, the public sector fades into the background of a larger drama in which private firms are in the leading role. The job of the state is to correct market failures and protect property rights.

A recent line of thinking in political economy examines the role of the state more closely. Mariana Mazzucato's 2013 book *The Entrepreneurial State* argues for a historical and normative corrective: historical in the sense that the state *has* played a foundational role in innovation, often underwriting the risky and capital-intensive investments on which later private-sector breakthroughs depend (e.g., GPS, touchscreen displays, the internet); normative in the sense that states *should* reclaim their more ambitious role in shaping markets.[11] For Mazzucato, the Apollo space program is a paradigmatic example of the state acting as entrepreneur: a public institution willing to absorb extraordinary risk, mobilize capital at scale, and direct innovation towards an ambitious collective goal that creates spillover benefits for the whole economy.

Mazzucato and others also argue that the role of the state in developing infrastructure can be viewed in this entrepreneurial light. Infrastructure can reorganize economic life by lowering transaction costs, coordinating activity across large populations, and enabling forms of production and commerce that would otherwise be impossible.[12] In these cases, the state shapes markets not primarily through targeted sectoral investments but through horizontal investments in shared infrastructure that many different actors are able to use. The logic applies not only to physical infrastructure, such as roads and bridges, but also to digital infrastructure.

The leading example of state investment in digital infrastructure is the internet. Emerging from a US Department of Defense research project in the 1960s and 1970s, the internet is a

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9 Joseph A. Schumpeter, "The Process of Creative Destruction," in *Capitalism, Socialism and Democracy* (Taylor & Francis Group, 2010), http://ebookcentral.proquest.com/lib/princeton/detail.action?docID=515353.

10 Clayton M. Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Boston, Mass: Harvard Business School Press, 1997).

11 Mariana Mazzucato, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths* (London: Anthem Press, 2013).

12 Mariana Mazzucato et al., "Digital Public Infrastructure and the Economics of Public Value: What Is 'Public' about DPI?," *Journal of Economic Policy Reform* 29, no. 2 (2026): 113–41, https://doi.org/10.1080/17487870.2026.2662285.

set of public protocols that anyone can use and that no private sector actor owns. On top of the internet's shared protocols, an extraordinary range of private actors have built the technologies that define our digital lives: search engines, social networks, streaming services, and online marketplaces. As such, the internet is often described as the original DPI.[13]

In a 1998 lecture, Steve Deering introduced the hourglass model, an enduring metaphor for the internet's structure. At the center of the hourglass sits a "narrow waist": a thin layer of common protocols designed to "maximize interoperability" while "minimizing the number of surface interfaces" that different systems would need to support.[14] This architectural simplicity is often credited with enabling the internet's extraordinary generativity. Because everyone agreed on the same underlying protocols, countless innovations—applications and services—could emerge at the edges without requiring centralized coordination. The internet offers one model for an innovation ecosystem defined by a public core and private innovation at the edge: in other words, "public rails, private innovation."

3. UPI's Design Philosophy

A thin public core supporting private innovation at the edge was the design philosophy of UPI, the fast payment system launched by NPCI in 2016. UPI was the culmination of a decade-long effort to modernize India's payment infrastructure and advance financial inclusion. The central feature of UPI's design, reminiscent of the internet, is interoperability.[15]

Broadly, interoperability is "the technical, semantic, and business compatibility that allows end users to transact seamlessly with each other across systems."[16] More simply, it describes different systems sharing a common language to communicate. Consider a world in which every bank operates its private ATM network. A customer of Bank A could withdraw cash only from Bank A's machines, even when the nearest Bank A machine was inconveniently located and Bank B had a machine next door. An interoperable network of ATMs lets any customer withdraw cash from any bank's machine, improving efficiency across the network and convenience for the user.

This, applied to the digital movement of money, is the basic idea that drives UPI. Users can choose any app within the UPI ecosystem to make and receive payments, regardless of their deposit banking relationship. However, the unbundling of deposit banking from payments—UPI's distinctive form of interoperability—was never valued for its own sake. For UPI's designers, interoperability was meant to incentivize competition among payment service providers and prevent the kind of lock-in that would allow a small number of powerful actors

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[13] The Center for Digital Public Infrastructure (CDPI), for example, writes, "The DPI movement is inspired by the open standards and specifications that created the Internet (TCP-IP, HTTP, HTML, SMTP, etc.) and mobile networks (GSM, SMS, LTE, etc.), which operated as the original digital infrastructure of the late 20th century, triggering a burst of public and private innovation that broke barriers and drove inclusion." Centre for Digital Public Infrastructure, "DPI Overview," September 30, 2026, https://docs.cdpi.dev/the-dpi-wiki/dpi-overview.

[14] Steve Deering, "Watching the Waist of the Protocol Hourglass," ICNP '98, Austin, TX, October 14, 1998, https://ant.isi.edu/csci551/images/3/32/Deering98a.pdf.

[15] For a more detailed history, see Jeremy McKey et al., "Inventing UPI: Notes on the Prehistory of India's Digital Payments Revolution," *Digital Rails*, June 19, 2026, https://digitalrails.substack.com/p/inventing-upi-notes-on-the-prehistory.

[16] Alexander Copestake et al., "Growing Retail Digital Payments: The Value of Interoperability," *Fintech Notes* (USA) 2025, no. 004 (2025): A001, https://doi.org/10.5089/9798229014250.063.A001.

to extract rent. Competition, in turn, was meant to drive innovation,[17] an explicit goal going back to the early days of the country's payment system modernization. As the Reserve Bank of India (RBI) stated in a 2005 report, "In a dynamic economy, markets need to play a key role in guiding the development of infrastructure, including mechanisms like payment systems. This means that innovation and competition will be central to the future development of the payment system—as they are in other areas of the economy."[18]

NPCI was launched in 2009 to develop the country's retail payment systems. Today, NPCI operates a range of payment schemes in addition to UPI, including India's largest ATM network, the credit card network RuPay, and an electronic toll collection system. NPCI has many characteristics of a public sector actor. First, it is majority-owned by public sector banks and has nonprofit status.[19] Second, as the only operator of retail payment systems licensed by RBI, it has a rule-setting role in the ecosystem that gives it a quasi-regulatory character.[20] Third, it is closely associated with and shaped by India's central bank.[21]

4. UPI's Successes and Limitations

India's payments landscape today is almost unrecognizable from a decade ago. The ubiquitous QR codes on vegetable stands, autorickshaws, and even temple donation boxes make India one of the easiest places in the world to make payments. Measured in terms of efficiency gains, advances in financial inclusion, or simply the aspiration of a unified payments ecosystem, UPI has been a resounding success. Understandably, it is a model that many countries seek to emulate.

But when it comes to the goal of UPI to advance competition and innovation through interoperability, the reality differed from what its designers had intended. While some competition at the application layer was evident in the early days of UPI, seemingly justifying the hypothesis that interoperability would create competitive innovation, the picture soon shifted. Most bank apps failed, and a trio of well-capitalized, third-party application providers quickly captured most of the market. NPCI began innovating in tandem, taking on a much larger role in the ecosystem than might be expected of an operator of a public payment rail,

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[17] The thesis that interoperability will advance competition and innovation has deep roots in Indian governance and technology policy, even beyond payments. See, for example, the 2011 report by the Technology Advisory Group for Unique Projects (TAGUP), convened by the Ministry of Finance. The group was tasked with articulating a common institutional framework for large, mission-critical government IT projects. They write: "One of the ways in which traditional infrastructure generates dynamic efficiency is by fostering competition through interoperability. Interoperability ensures seamless interaction and collaboration among various entities within shared systems, facilitating competition in diverse sectors…The adherence to standardized protocols has facilitated the entry of multiple players, creating a competitive environment where various entities can contribute innovative solutions and services." Nandan Nilekani et al., *Report of the Technology Advisory Group for Unique Projects* (Ministry of Finance, 2011), https://www.researchgate.net/publication/390162299_Report_of_the_Technology_Advisory_Group_for_Unique_Projects_TAGUP_Report.

[18] *Payment Systems in India – Vision 2005-08* (Reserve Bank of India, 2005), https://publish-01.obsidian.md/access/bb8650237af1f471066d0c81eda3adb9/MyFiles/RBI_Reports_20050503_%20Payment%20Systems%20in%20India%20-%20Vision%202005-08.pdf.

[19] NPCI was chartered as a Section 8 (not-for-profit) company. The Payment and Settlement Systems Act of 2007 required NPCI to be at least 51% owned by public-sector banks.

[20] Advait Palepu, "Deciphering NPCI's Dominance in Digital Payments," *MEDIANAMA*, October 28, 2020, https://www.medianama.com/2020/10/223-deciphering-npcis-dominance-in-digital-payments-2/.

[21] William Cook and Anand Raman, *National Payments Corporation of India and the Remaking of Payments*, Working Paper (Consultative Group to Assist the Poor (CGAP), 2019), https://www.cgap.org/research/publication/national-payments-corporation-of-india-and-remaking-of-payments.

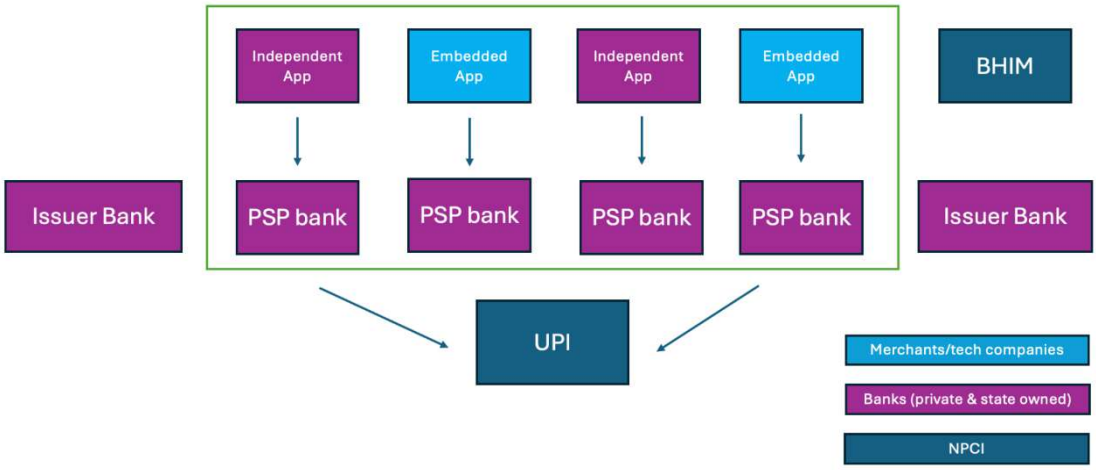
resulting in the innovative center of gravity within the UPI ecosystem shifting from the private sector to the public sector.

4.1 UPI at Launch

Banks can join the UPI ecosystem in two ways: as issuers, which is the basic tier of membership, holding customer accounts that can send and receive payments over UPI; or as Payment Service Providers (PSPs), which is a higher tier of membership and enables them to build front-end applications on top of UPI rails. PSPs face more stringent data-protection requirements and a higher auditing burden, among other licensing conditions. Today, 110 banks participate in UPI as PSPs and an additional 631 banks as non-PSP issuers.[22]

Whether as a PSP or an issuer, joining UPI requires a bank to agree to full interoperability at the application layer. This means that a person who holds a deposit in Bank A is not restricted to Bank A's front-end payment application and can choose to use Bank B's application.[23] A person who holds a deposit in Bank A need not be a payment customer at Bank A. Banks can compete for deposit holders and payment customers separately, which benefits the consumer, who has the option to select the best service in each domain.[24]

Figure 1: UPI's Original Architecture



Note. Authors' own, based on 2016 guidelines. The green box demarcates the domain of UPI's distinctive interoperability. A deposit holder at any PSP within the box could choose to make payments through any app, independent or embedded, of any other PSP bank within the box. Issuer banks participate in the UPI system but do not have their own application layers and therefore do not compete for payment customers.

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22 NPCI, "UPI Live Members - List of Banks Live on UPI," accessed October 16, 2026, https://www.npci.org.in/product/upi/all-members. In other words, all PSP banks are issuers, but not vice versa. In the nomenclature used by NPCI today, both PSP and (mere) issuer banks are described as UPI members.

23 In this scenario, both Bank A and Bank B are PSPs, since we are assuming that each has an application that a user can choose to use. For deposit holders at non-PSP issuer banks, the distinction is moot, since the user would need to find another entity's application in any case.

24 Copestake et al., "Growing Retail Digital Payments."

At the outset, banks had reservations about the original design of UPI and that it might turn the banks into "dumb pipes" for financial transactions.[25] But the new architecture also created opportunities. If a bank's own customers could migrate to rival banks' payment applications, deposit holders of competing banks could also become (payment) customers. UPI's interoperable architecture therefore introduced competitive pressure across the banking sector, creating incentives to develop more attractive payment interfaces and services.

A wave of launches in the months following UPI's debut suggested that the competitive pressures built into the system might indeed be stimulating innovation, just as policymakers had hoped. In August 2016, Axis Bank launched its UPI application,[26] as did ICICI Bank.[27] In November, the State Bank of India, India's largest public sector bank, became the 18th bank to launch its own UPI-enabled application.[28] By the end of the year, a competitive race was evolving as banks rushed to develop the most attractive and technologically sophisticated payment interfaces for the new interoperable ecosystem.

4.2 The Rise of Third-Party Apps

Banks were not the only players in this race. Two non-bank entities soon entered the mix, competing for valuable market share as the interface of choice in the new UPI ecosystem. The first was BHIM, a public sector app built by NPCI on top of its own rails. NPCI launched BHIM in December 2016 to help drive faster UPI adoption. It was intended as a service for smaller banks that joined or sought to join UPI as PSPs but lacked the technical capacity to build their own competitive, user-facing payment apps. BHIM offered a solution by allowing a bank to integrate the BHIM interface into its back-end systems, while still preserving its own branding.[29] BHIM was initially widely successful, exceeding 40% market share for several months in 2017.[30]

The second was BHIM's primary competitor, PhonePe, which was a fintech company founded in December 2015 and shortly thereafter acquired by the e-commerce company Flipkart. Together with the bank apps, BHIM and PhonePe offered three distinct entry points for users seeking to participate in India's digital payments revolution: through the banking sector; through the public sector; and through an emerging fintech sector.

Market Share (Transaction Volume) of BHIM, PhonePe, and Bank Apps in May 2017

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[25] William Cook and Anand Raman, *National Payments Corporation of India and the Remaking of Payments*.

[26] FE Bureau, "Axis Bank Ready to Go Live with UPI," *The Financial Express* (Mumbai), August 6, 2016, https://www.financialexpress.com/business/banking-finance-axis-bank-ready-to-go-live-with-upi-339800/.

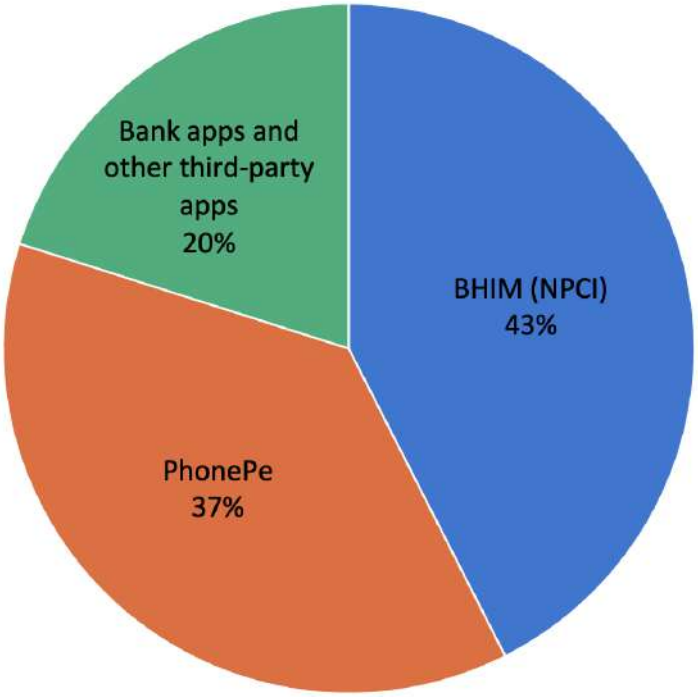
[27] Pratik Bhakta, "ICICI Bank Goes Live on Play Store with Its UPI App," *The Economic Times*, August 30, 2016, https://economictimes.indiatimes.com/industry/banking/finance/banking/icici-bank-goes-live-on-play-store-with-its-upi-app/articleshow/53929076.cms.

[28] Mayank Jain, "SBI Enters Unified Payments Interface Arena With SBI Pay," *NDTV*, November 24, 2016, https://www.ndtvprofit.com/business/sbi-enters-unified-payments-interface-arena-with-sbi-pay-10560463.

[29] William Cook and Anand Raman, *National Payments Corporation of India and the Remaking of Payments*.

[30] NPCI, "BHIM Analytics," accessed October 16, 2026, https://www.npci.org.in/product/bhim/product-statistics; NPCI, "Unified Payments Interface (UPI) Product Statistics," accessed October 16, 2026, https://www.npci.org.in/product/upi/product-statistics.

Figure 2: Early Competitive Landscape of the UPI Ecosystem, with Market Share in UPI Transactions[31]



PhonePe is one example of what NPCI later called "third-party app providers." The idea first appeared in NPCI's 2016 procedural guidelines, which distinguish between "independent" and "embedded" apps. Rather than building its own independent app, a PSP bank could participate in UPI by "embedding" its payment service in a partner's app. The guidelines set out precise conditions for doing so, all intended to keep the bank firmly in control.[32] Presumably, UPI's designers expected these partnerships to benefit both sides, giving banks a better front end and merchants a payment option inside their apps, while also serving consumers.

In August 2016, PhonePe partnered with Yes Bank to offer the first such embedded app in the UPI ecosystem,[33] allowing users to pay directly for Flipkart products within the Flipkart app via Yes Bank's PSP membership. The PhonePe–Yes Bank partnership, however, highlighted several problems with the embedded app model. In January 2017, ICICI Bank entered a public dispute with PhonePe and its owner, Flipkart, accusing them of a "restrictive practice": the Flipkart app steered shoppers to pay through PhonePe's own UPI handle rather than letting

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31 PhonePe, "PhonePe Sees 100% Month over Month Growth," Press Release, June 7, 2017, https://www.phonepe.com/press/phonepe-sees-100-month-over-month-growth/; NPCI, "BHIM Analytics," accessed October 16, 2026, https://www.npci.org.in/product/bhim/product-statistics; NPCI, "Unified Payments Interface (UPI) Product Statistics," accessed October 16, 2026, https://www.npci.org.in/product/upi/product-statistics. For May 2017, PhonePe reported 3.5 million UPI transactions, NPCI reported 3.98 million transactions for BHIM, and 9.36 million total UPI transactions were recorded for the month. The category for bank apps and other third-party apps is calculated by subtracting the PhonePe and BHIM statistics from the total UPI transaction volume.

32 NPCI, *Unified Payments Interface Procedural Guidelines* (National Payments Corporation of India (NPCI), 2016), https://web.archive.org/web/20160909205024if_/http://www.npci.org.in:80/documents/UPI_Procedural_Guidelines.pdf. The guidelines clarify, "The UPI payment app must contain the PSP logo and look and feel for the customer irrespective of the UPI app distribution mode (embedded or independent)." Further, "While the bank's technology platform can be outsourced, its functions 'as a PSP' cannot be outsourced."

33 Antony Peyton, "PhonePe and Yes Bank Unveil India's 'First' UPI-Based Payments App," FinTech Futures, August 30, 2016, https://www.fintechfutures.com/paytech/phonepe-and-yes-bank-unveil-india-s-first-upi-based-payments-app.

them choose any UPI app, including ICICI's. In response, ICICI blocked its customers from transacting using PhonePe.[34] Although NPCI intervened, requiring ICICI to lift the block, it did acknowledge the underlying issue: when a successful technology company partners with a single PSP bank to provide a payment interface, the sponsoring bank has an unfair advantage, since it has visibility into all of the payments data that runs through the app.[35] A related concern was reliability: a payment app was only as reliable as its sponsoring bank, which created the risk that a bank outage could bring down a large share of the country's payments infrastructure.[36]

NPCI responded with a pair of circulars, issued on September 15, 2017,[37] that reshaped the relationship between banks and their technology partners, now renamed "third-party app providers" (TPAPs). In the most important change, the "multiple bank model," a TPAP would need to seek permission directly from NPCI to operate on the UPI rails, naming up to five partner banks as well as details about its user base as part of the licensing process. In turn, NPCI would "provide the NPCI Common Library (CL) directly," rather than through a bank's software. The 2016 guidelines had expressly forbidden this exchange, clarifying NPCI's libraries could "under no condition" be handed to a merchant except inside a bank's app.

This seemingly minor regulatory change marked a shift in the balance of power between banks and technology companies in India's payment system. Formally, UPI remained bank-led: every TPAP still reached the system through PSP banks, and virtual payment addresses still belonged to those banks. But a TPAP no longer depended on any single bank. The change recognized a reality that was already clear to users: the future of India's payment interface would lie with fintechs and not banks. This was already true of PhonePe, which had rapidly won user affection and market share, and it was soon to become true of another non-bank fintech player that would enter the market, partnering with four banks, three days after NPCI introduced the multi-bank model: Google Tez,[38] later rebranded Google Pay.

4.3 Competition Implications

Since May 2017, when a public app (BHIM), bank apps, and a private fintech company (PhonePe) all claimed meaningful market share and engaged in serious competition, the context around UPI has evolved. Bank apps have since become obsolete, and BHIM's market

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[34] Shashidhar KJ, "ICICI Bank Removes Block on UPI Transactions from PhonePe," *MEDIANAMA*, February 2, 2017, https://www.medianama.com/2017/02/223-icici-bank-removes-block/.

[35] NPCI's immediate remedy was to require Flipkart to allow payments through all UPI apps, not just PhonePe. Ibid. See also NPCI circular 15A.

[36] This happened in March 2020, when Yes Bank was placed under an RBI moratorium, causing a temporary outage for PhonePe and numerous other fintech and e-commerce companies that had partnered with the bank. See: Trisha Jalan, "PhonePe Services Restored with ICICI Bank as New Partner," MEDIANAMA, March 12, 2020, https://www.medianama.com/2020/03/223-phonepe-services-restored-with-icici-bank-as-new-partner/.

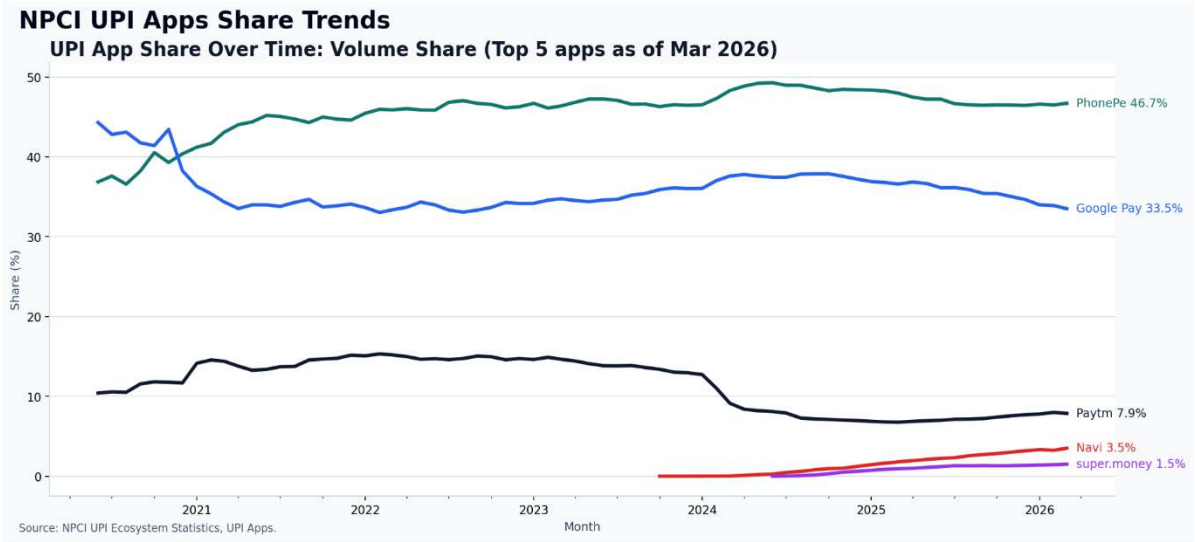
[37] NPCI, *Unified Payment Interface: Multiple Bank Model (API Approach)*, UPI Operating Circular NPCI/UPI/OC No. 32/2017-18 (2017), https://web.archive.org/web/20250327081128/https://www.npci.org.in/PDF/npci/upi/circular/2017/UPI%20Circular%20no%2032_Multi-Bank%20Approach_15th%20Sept.pdf; NPCI, *Single PSP Model Merchant Integration (Addendum Circular 15B)*, UPI Operating Circular NPCI/UPI/OC No. 15B/2017-18 (2017), https://web.archive.org/web/20250810013159/https://www.npci.org.in/PDF/npci/upi/circular/2017/UPI%20Circular%2015B_single%20PSP%20Model_SDK%20approach%2015%20Sept.pdf.

[38] "Tez" means "fast" in Hindi.

share is around 1%.[39] In the current landscape, Google Pay and PhonePe together claim 80% of the market, with Paytm in a distant third place at an 8% market share. Though nearly 50 apps are licensed to operate on UPI, the vast majority have a market share below 1%.[40]

Why did this market concentration emerge, despite an interoperable design that was explicitly intended to promote competition? One potential explanation for the dominance of Google Pay and PhonePe is that they are well-built apps. Banks have historically struggled with building technology.[41] UPI's architecture gave banks the best possible shot at designing competitive apps, and certainly many tried. But users preferred the interface provided by fintechs over those built by banks. From this perspective, the dominance of Google Pay and PhonePe reflects the success of UPI's interoperable architecture.

Figure 3. NPCI UPI Apps Share Trends (June 2020–March 2026)



Note. Generated from monthly NPCI data on UPI app shares by volume of transactions. https://www.npci.org.in/product/ecosystem-statistics/upi.

Interoperability gives users choice and rewards superior service. The general assumption is that interoperability pushes for competition by lowering barriers to entry and preventing powerful companies from building competitive moats. However, the Indian story shows that interoperability can also swing in the opposite direction, eliminating frictions that prevent companies that have other advantages from dominating the market. Google Pay and PhonePe were able to scale rapidly because of an architecture that prevented banks from locking in their deposit holders as payment customers. Banks' captive customers became contestable, and two firms won most of the contest by being willing to invest in acquiring customers.

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[39] PTI, "BHIM App Eyes Doubling of Market Share, Targets Feature Phone Users to Deepen Financial Inclusion," ETBFSI.Com, May 20, 2026, https://bfsi.economictimes.indiatimes.com/news/financial-services/bhim-app-eyes-doubling-of-market-share-targets-feature-phone-users-to-deepen-financial-inclusion/131225037.

[40] NPCI, "UPI Live Members - List of Banks Live on UPI."

[41] Daniel Awrey, *Beyond Banks: Technology, Regulation, and the Future of Money* (Princeton, New Jersey: Princeton University Press, 2024), https://catalog.princeton.edu/catalog/99131274011406421.

This outcome suggests a difficult trade-off between letting a market grow unimpeded without regard to the concentration effects and intervening to preserve competition. On paper, NPCI has treated concentration as a risk. In November 2020, NPCI published a circular capping any single TPAP's share of total UPI transaction volume at 30%, to take effect in January 2021.[42] The rule was framed in the language of systemic risk: if a dominant app went down, so might India's payments infrastructure. Existing players were given until January 2023 to comply. That deadline was extended by two years, then extended again; as of writing, the cap remains on the books but is unenforced, with the latest compliance deadline set at December 2026.[43] The deeper problem was always practical. Short of placing active limits on user transactions, which would be in contradiction to the government's push for mass digital adoption, it was never clear how a dominant app was supposed to shed market share.[44]

5. Public Innovation and Private Service Delivery

Measuring innovation is an imperfect art. It is hard to know what counts as an innovation or how to weigh the relative significance of different innovations. Not all, of course, are equal. Using the OECD definition of innovation, however, allows us to paint a rough picture of innovation in the UPI ecosystem. Where are "new or improved" products and processes coming from? What is the role of competition in helping generate these products and processes? Two results are surprising given UPI's original design. First, there is considerable evidence that NPCI is equally, if not more, important for innovation in the UPI ecosystem than private actors. Second, competition does not appear to be the force that is driving innovation.

Both of these findings reflect the evolution of NPCI's role in the UPI ecosystem vis-à-vis private actors. At the most basic level, NPCI is a system operator and a scheme manager: it sets the rules for participation and the flow of messages (scheme manager) while also operating the physical infrastructure through which the scheme is rolled out (system operator). But today, NPCI also plays a third role: it develops new products and services that go beyond operating a system or managing a scheme. NPCI has become, in its own right, a product innovator.[45] This role is a distinctive feature of the Indian payment ecosystem.

Meanwhile, although the TPAPs themselves also regularly push out new features, we found ample evidence that many of those features are simply rollouts of products that NPCI has already built. This supports a view of the TPAPs as playing a service delivery function rather than (primarily or exclusively) an innovation function.[46]

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[42] Advait Palepu, "NPCI Introduces Market Share Cap of 30% on UPI Players," *MediaNama*, November 6, 2020, https://www.medianama.com/2020/11/223-npci-introduces-market-share-cap-of-30-on-upi-players/.

[43] Jaspreet Kalra, "Exclusive: India to Again Delay Caps on UPI Payments Market Share," Finance, *Reuters*, May 9, 2024, https://www.reuters.com/business/finance/india-delay-payments-market-cap-helping-walmart-backed-phonepe-google-pay-2024-05-09/.

[44] It is notable that, as a new layer of TPAPs emerged and itself became highly concentrated, similar dynamics were unfolding in the banking sector. Between 2011 and 2021, the market share of India's three largest banks increased by roughly ten percentage points. "Bank Concentration for India," May 7, 2024, https://fred.stlouisfed.org/series/DDOI01INA156NWDB.

[45] The authors are indebted to a conversation with David Porteous that helped to clarify these different roles.

[46] See Appendix A for a comparative analysis of NPCI and PhonePe innovations from 2017 to 2025.

5.1 Three Modes of NPCI Intervention

BHIM was NPCI's first foray into making a product. The next major wave of innovations came in 2018, with the launch of a suite of features branded as UPI 2.0. At the launch event, NPCI's leadership introduced overdraft facilities, invoice capabilities, and automatic bill payments. In a prerecorded video, Dilip Asbe, who had taken the reins as CEO earlier that year, ticked off the four pillars of NPCI's culture,[47] with the first pillar being innovation.

Additional waves of product launches came in 2022, 2023, and 2025 and included functionalities to include phones (UPI 123 Pay), an on-device wallet for smaller payments (UPI Lite), and linkages to RuPay credit cards, NFC-based tap payments, and face authentication, which allowed users to approve payments through Aadhaar-linked biometrics. More recently, NPCI has taken steps towards integrating payments and AI. At the February 2026 India–AI Impact Summit, NPCI launched FiMI (Finance Model for India), a language model adapted from Mistral's open-weight architecture and trained on India-specific payments data.[48] The model is intended to support natural-language customer inquiries across the UPI ecosystem.

A tour through NPCI's operating circulars in Appendix A shows an organization that prizes innovation. The pace of feature launches partly reflects NPCI's status as a Section 8 not-for-profit company, which obligates it to cycle any surplus back into its own products.[49] The UPI features launched by NPCI over the past decade can be classified into three categories, each with different implications for users, firms, and the market architecture:

- **System-level innovations:** These are innovations that only the operator of the rails could develop, where a new product is in reality a change to the scheme rules, often implementing updated guidance from RBI. Consider, for example, UPI Lite, launched in 2022, which enabled on-device wallets for small payments. Digital wallets have a long history in India and are popular in other parts of the world; NPCI did not create them. But it did enable them to participate in a payment scheme that was previously limited to direct bank transfers. In this case, a change in the rules created a new category of UPI products, which private firms then built into their own offerings. Today, all the major TPAPs offer on-device wallets via UPI Lite.
- **Application-level innovations:** NPCI has repeatedly entered the market with products that compete with private alternatives. BHIM is the clearest case: a consumer payment app built by NPCI, launched into a market where PhonePe and several banks had already released UPI apps. A more recent example is Hello! UPI, the voice interface for payments that NPCI launched in 2023, built on open-source government language models.[50] Private

[47] NPCI, *UPI 2.0 Launch Event*, 2018, 01:34:47, https://www.youtube.com/watch?v=MgzvQkNTnTk, starting around minute 20:30

[48] Aboli Kathar et al., "FiMI: A Domain-Specific Language Model for Indian Finance Ecosystem," arXiv:2602.05794, preprint, arXiv, February 13, 2026, https://doi.org/10.48550/arXiv.2602.05794.

[49] Giselle Labrador-Badia helpfully observed that the rapid pace of innovation reflects not only NPCI's institutional culture but also its legal structure as an organization required to reinvest surplus into product development.

[50] Pushpa Marwal, "The NPCI's Hello! UPI Is Ready To Transform Digital Payments In India," *Forrester*, November 9, 2023, https://www.forrester.com/blogs/npcis-hello-upi-ready-to-transforms-digital-payments-in-india/.

firms remain free to build their own voice assistants and may find better ways to do it. But any firm that builds a voice payment interface now competes against a public default supplied by the operator of the rails.

- **Co-option:** A third kind of NPCI-led change sits between the other two, whereby NPCI takes a product line that private firms built on top of its rails and incorporates it into UPI's interoperable architecture. Subsequently, what had been one firm's competitive advantage became part of the standard package available to every app. Soundbox speakers, which verbally confirm transactions for merchants, are an example. Paytm launched the first line of soundboxes in 2019, followed by PhonePe's SmartSpeaker in 2022[51] and Google Pay's Sound Pod in 2024.[52] More than 30 million soundboxes are in use across India today, and they represent a highly profitable business line item for TPAPs. In May 2026, the Economic Times reported that NPCI was building a common, interoperable soundbox platform that would let merchants link every app's QR code to a single device.[53] For merchants, the benefit is obvious; for the firms that built the market, the plan threatens to turn a profitable product line into a common feature of the rails.

System-level features are the type of innovation that any payment system operator, whether public or private, is expected to deliver. However, NPCI introducing features via the other two modes—application-level and co-option—is distinctive to the UPI ecosystem and important for understanding how the market structure has evolved. NPCI's innovation cuts in two directions. On the one hand, by creating its own product lines and mandating interoperability among existing products, NPCI lowers prices for consumers and merchants. But lower prices come at a cost: Private firms have less incentive to invest in new product lines that could be highly profitable if they believe that the rail operator may simply co-opt those innovations.

Recall Deering's hourglass. The model is widely remembered; the context in which he introduced it is not. The "narrow waist" was not simply a description of the internet's architecture; it was an ideal that Deering feared was already eroding as new functions and controls were pushed into the middle layer, thickening the core of the network. For Deering, this was a structural danger, threatening the openness and generativity that the narrow waist had made possible; the title of his lecture, "Watching the Waist of the Protocol Hourglass," betrays his concern. The internet's edge, for all its early diversity, has since concentrated around a handful of dominant firms. Interoperable protocols did not prevent that concentration in the case of the internet, just as they did not prevent it in UPI.[54] The result is a tension that sits at the heart of the UPI story—that of keeping UPI cheap and accessible, in

[51] PhonePe, "PhonePe Launches Smart Speaker for Reliable & Convenient Payment Tracking at Stores," Press Release, August 4, 2022, https://www.phonepe.com/press/phonepe-launches-smart-speaker-for-reliable-convenient-payment-tracking-at-stores/.

[52] Gloria Mathias, "Google Pay Launches SoundPod to Boost Digital Payments in India," February 26, 2024, https://ibsintelligence.com/ibsi-news/google-pay-launches-soundpod-to-boost-digital-payments-in-india/.

[53] Pratik Bhakta, "One Soundbox Soon for All Payment Apps as NPCI Readies Platform," *The Economic Times*, May 18, 2026, https://economictimes.indiatimes.com/tech/technology/one-soundbox-soon-for-all-payment-apps-as-npci-readies-platform/articleshow/131160676.cms.

[54] Steve Deering, "Watching the Waist of the Protocol Hourglass," ICNP '98, Austin, TX, October 14, 1998, https://ant.isi.edu/csci551/images/3/32/Deering98a.pdf.

the service of inclusion, and preserving the incentives that draw private firms to invest and innovate on the rails. Nowhere is that trade-off sharper than in the longstanding debate over the merchant discount rate (MDR), culminating most recently in the re-introduction of modest fees on UPI transactions.

5.2 Implications of the MDR Debate

MDR is the fee a merchant pays, as a percentage of each transaction, for accepting a digital payment. In card networks, it is divided among the issuing bank, the acquiring bank, and the card network itself. When UPI launched, a modest MDR was permitted on certain person-to-merchant transactions. In 2019, however, legislators amended the Payment and Settlement Systems Act to prohibit MDR on UPI transactions entirely, with effect from January 1, 2020. That amendment allowed UPI the characteristic that it has been closely associated ever since, i.e., it was free. As of writing, a modest MDR has been re-introduced on larger merchant payments,[55] prompting soul-searching across the Indian payments world about who should bear the costs and reap the profits of a public payment system and what "free" really means.

However, as David Porteous stated, free does not mean costless.[56] Running a payment system at UPI's scale is expensive. Beyond the IT infrastructure, costs include fraud prevention, dispute resolution, customer service, staff training, and marketing. Banks bear the largest share, since every transaction runs through their systems, while TPAPs bear the costs of their own technology and of acquiring users. One estimate places the total cost of the UPI system at INR 20,000 crore (approximately USD 2 billion).[57] The government has covered part of these costs through an evolving rebate scheme for banks, which in one iteration paid banks 0.15% of the value of UPI payments exceeding INR 2,000, conditional on banks meeting standards for uptime and failed transactions.[58] But these subsidies covered only a fraction of the costs involved, while banks and TPAPs covered the rest.

In terms of competition, zero MDR may help explain the market dynamics described above. Interoperability was designed to promote competition by lowering barriers to entry. But zero pricing gave a de facto advantage to firms that were willing to offer free services at a loss for years in the expectation of later monetizing data through advertising and cross-selling adjacent financial services, in addition to hardware such as soundboxes. For smaller firms without deep pockets, the lower barriers to entry had limited effects without a clear pathway to profit.

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[55] Reuters, "Explainer -- India's UPI MDR Shake-up: What Changes and Why It Matters," *The Economic Times*, September 16, 2026, https://economictimes.indiatimes.com/news/economy/finance/explainer-indias-upi-mdr-shake-up-what-changes-and-why-it-matters/articleshow/134280211.cms.

[56] David Porteous, "Who Pays for Instant Payments?," *Center for Financial Inclusion*, November 24, 2025, https://www.centerforfinancialinclusion.org/brief/who-pays-for-instant-payments/.

[57] Anupam Manur, "UPI Was Never Really Free. We Just Never Saw the Cost of Keeping It That Way," *The Times of India*, September 20, 2026, https://timesofindia.indiatimes.com/toi-blogs/nation-notes/upi-was-never-really-free-we-just-never-saw-the-cost-of-keeping-it-that-way/articleshow/134357264.cms.

[58] PIB Delhi, "Cabinet Approves Incentive Scheme for Promotion of Low-Value BHIM-UPI Transactions (P2M)," Press Release, March 19, 2025, https://www.pib.gov.in/PressReleasePage.aspx?PRID=2112771&reg=48&lang=2.

In this reading, zero MDR and interoperability worked at cross-purposes. Interoperability lowered barriers to entry, eliminating the competitive moats that might otherwise have kept smaller newcomers out. However, entering a market still requires a viable business strategy, and eliminating MDR removed one of the clearest paths to profitability for newcomers, instead benefiting the entities that did not need to be profitable in the short term.

6. Lessons and Insights

UPI's designers set out to build something like the internet, with a narrow waist of common protocols, publicly owned, on which private firms would build and innovate. This paper traced two developments that departed from that design. First, the application layer became more concentrated than policymakers had expected. Second, the protocol layer grew wider than intended, as NPCI took on an expanding role as an innovator.

In his 2018 keynote address for the UPI 2.0 launch event, Nandan Nilekani situated UPI within a much larger historical transition from physical cash to digital money.[59] He worried that digitization would "inevitably lead to a privatization of money" unless the government acted strategically to prevent the creation of new monopolies and preserve public interest values. The challenge for UPI is that the goal of private-sector innovation and competition can come into tension with the goal of inclusion. As other countries seek out the UPI template when designing their own payment systems, it is worth highlighting some lessons learned.

Architectural reversibility. Choices about interoperability should be made with their distributional consequences in view, and revisited when those consequences diverge from intent. The unbundling of payments from deposit banking was a decisive architectural move in UPI's history, and NPCI's market-cap rule—capping any single third-party app at 30% of volume—was an attempt to retrofit a constraint after the architecture's effects had already played out. The retrofit has been repeatedly deferred and may prove unenforceable. The principle is that architectural commitments should be reversible by design, not reversible only through political will. In other words, the reversal mechanism should be built in at the start, not assembled under pressure later.

Pricing as policy. Zero-fee is not a neutral choice. It is a pricing decision with structural consequences for those who can afford to innovate above the rail. Without revenue at the edge, the edge cannot sustain diverse, distributed innovation. The lesson is not that zero-fee is a mistake but that interoperability, zero pricing, and scale economies will together concentrate the application layer. The DPI community has tended to treat pricing as a question of inclusion; it is also a question of market structure. Future systems should model the relationship between fee structure and the diversity of the application layer directly and should be prepared to introduce limited fees, cross-subsidies, or differentiated pricing where

[59] NPCI, *UPI 2.0 Launch Event*, 2018, 01:34:47, https://www.youtube.com/watch?v=MgzvQkNTnTk, starting around minute 44.

the goal is to keep competition alive above the rail. Pricing and architecture must be designed together, not in sequence.

Capacity for the public layer. If public innovation is the equilibrium rather than the fallback, the institutions that operate DPI must be resourced and governed for it. NPCI's expanded role was not anticipated in its founding charter, and its accountability structures were designed for a narrower function than it now performs. Public infrastructure operators should be designed for the functions they will actually perform, including product innovation and user-facing design, and held to governance arrangements proportionate to that role.

The form lock-in takes, as well as its durability, matter. The four-fifths share held by PhonePe and Google Pay looks structurally similar to the Visa-Mastercard duopoly in the United States. However, whereas Visa and Mastercard operate proprietary closed-loop systems—wherein displacing them would have coordination costs across the entire merchant base—UPI's rails are public, and the application layer sits atop an interoperable substrate that NPCI controls. A regulatory intervention that displaced one of the two apps would be costly but not catastrophic, because the rail beneath them would persist. This is the structural difference between concentration on private infrastructure and concentration on public infrastructure, and it is an important feature of the DPI approach. The lock-in is shallower. Whether that matters depends on whether the regulator uses the room it has.

Appendix A: Comparison of Payment Features Launched by NPCI and PhonePe, 2017-2025

Drawing on the OECD definition of innovation discussed in Section 2, the table below lists payment features launched by NPCI and PhonePe between 2017 and 2025. NPCI features are drawn from NPCI's UPI operating circulars (41 features across 222 circulars during the nine years in question). PhonePe features are drawn from PhonePe's press releases (39 features across 219 releases). Both lists are likely undercounts. Not all NPCI operating circulars are public, and not all PhonePe features would be announced in a press release, especially if the feature is more technical. Moreover, an operating circular and press release serve different functions and provide an imperfect comparison. Nevertheless, even an imperfect comparison of feature launches between UPI's public operator and its largest private player supports the paper's central claim that public innovation has been as important in the UPI ecosystem as private innovation, if not more important.

The third column ("Type") answers a yes/no question for each feature. For an NPCI feature, does it compete with a PhonePe feature? For a PhonePe feature, is it a rollout of an NPCI feature? We found that roughly a quarter of NPCI features directly compete with PhonePe features and a third of PhonePe features are rollouts of NPCI features. In other words, much of the innovation emerging from NPCI exists on top of the rail that it operates, and much of the innovation emerging from PhonePe performs a service delivery function by making NPCI features available to the public.

What counts as a "payment feature" versus a feature that is unrelated to payments is an imprecise boundary. In the case of NPCI, we assume that any new feature referenced in a UPI operating circular is a payment feature. For PhonePe, the distinction is harder to draw. We code 84 of the 219 press releases in our data set as the launch of a new feature (as opposed to, say, announcing a milestone of transactions). Six of those features, for example, relate to buying and selling gold. While these features are innovations in the sense of the OECD definition, we do not code them as payment innovations, even though buying and selling gold does involve payments. By contrast, we view features such as PhonePe's Bluetooth point-of-sale device (P1) or autopay functionality (P3, P5, P14) as directly related to payments.[60]

[60] Credit is a borderline case. We view credit innovations as payment-related insofar as they integrate existing credit products into the menu of payment options (e.g., P2 and N26), but we do not explore innovation in adjacent credit markets that, for example, use UPI data to create new risk profiles and package loans. We also confront the question of when, in OECD's language, a new product or process "differs significantly from the unit's previous products or processes." For example, we code updates to PhonePe's SmartSpeaker as a new feature in each case where a press release mentions one, even in cases where the update might not rise to the level of a significant difference (see, e.g., P27).

NPCI and PhonePe Payment Features

Feature	Description	Type	Source
2017			
NPCI		***Compete with PhonePe feature?***	
N1 Corporate disbursements	Lets companies pay out to individuals (salaries, refunds, benefits) via UPI.	No	OC 24
N2 Bharat QR integration†	UPI apps must scan Bharat QR codes carrying UPI credentials.	No	OC 28
N3 Third-party app (TPAP) models	Single-PSP and multi-bank models that let non-bank apps (e.g., Google Pay, PhonePe) run on UPI.	No	OC 32; OC 15B
PhonePe		***Rollout of NPCI feature?***	
P1 Bluetooth POS device	POS device that takes payments when a phone is held near it.	No	PR, 31 October 2017
2018			
NPCI		***Compete with PhonePe feature?***	
N4 Foreign inward remittances	Remittances from abroad credited to Indian accounts through UPI.	No	OC 48; OC 173
N5 Bill payments (BBPS) on BHIM	Bharat BillPay bill payments inside the BHIM app.	Yes (PhonePe bill payments)	OC 50
N6 UPI 2.0: Overdraft account linking	Overdraft accounts can be linked to UPI and used to pay.	No	OC 56
N7 UPI 2.0: One-time mandate (funds blocking)	Pre-authorize a payment and block the funds for later debit.	Yes (PhonePe AutoPay)	OC 56
N8 UPI 2.0: Invoice in the inbox	Customers can view a merchant's invoice in the app before paying.	No	OC 56
N9 UPI 2.0: Signed intent and QR	Merchant intents and QR codes carry a digital signature so apps can verify the payee.	No	OC 56
PhonePe		***Rollout of NPCI feature?***	
P2 Credit card bill payment	Pay Visa credit card bills from the PhonePe app.	No	PR, 25 January 2018
P3 AutoPay with Ola	Automatic payment for Ola rides booked in PhonePe.	No	PR, 14 June 2018
2019			
NPCI		***Compete with PhonePe feature?***	
N10 IPO on UPI†	Retail investors apply for IPOs with a UPI mandate that blocks funds until allotment.	No	OC 71; OC 56

Feature	Description	Type	Source
N11 P2PM category	Onboarding category for small merchants.	No	OC 70
PhonePe		***Rollout of NPCI feature?***	
P4 Payments keyboard	Android keyboard for sending, requesting money and checking balances from inside the app.	No	PR, 30 April 2019
P5 AutoPay for Tata Sky	Automatic monthly recharges through a one-time mandate.	No	PR, 20 August 2019
P6 IPO bids via UPI	First non-bank app to let users apply for IPOs with a UPI mandate that blocks funds.	Yes (N10)	PR, 17 September 2019
2020			
NPCI		***Compete with PhonePe feature?***	
N12 PAN validation API	API for third parties to validate a customer's PAN through UPI.	No	OC 80
N13 UPI AutoPay†	Recurring e-mandates for bills and subscriptions from any UPI app.	Yes (PhonePe AutoPay products)	OC 100
N14 UPI Global (international merchant acceptance)	UPI users pay merchants abroad.	No	OC 117; OC 93
N15 Backup / secondary UPI ID	Third-party apps can route payments through a secondary handle when the primary bank is down.	No	OC 94
N16 B2B merchant category	Business-to-business payments as a separate merchant category.	No	OC 96
N17 UDIR / UPI Help (dispute resolution)	In-app complaint and dispute handling for UPI transactions.	No	OC 98
PhonePe		***Rollout of NPCI feature?***	
P7 Chat	Users chat with each other while requesting or confirming payments.	No	PR, 3 February 2020
P8 PhonePe ATM (cash at shops)	Shops accepting PhonePe can dispense cash to users	No	PR, 6 February 2020
P9 Visa Safe Click	One-click Visa card payments without OTP for small amounts.	No	PR, 19 March 2020
P10 Voice notifications	Spoken payment confirmations for merchants in 9+ languages.	No	PR, 22 December 2020
2021			
NPCI		***Compete with PhonePe feature?***	
N18 UPI Number†	Use a mobile number as a UPI ID.	No	OC 115

Feature	Description	Type	Source
N19 Cross-border country tie-ups	UPI acceptance and remittances linked to foreign payment systems.	No	OC 117
N20 e-RUPI (UPI prepaid voucher)	Purpose-specific prepaid vouchers redeemed via UPI.	No	OC 112
N21 Aadhaar OTP onboarding	Set a UPI PIN with Aadhaar OTP instead of a debit card.	No	OC 116
PhonePe		***Rollout of NPCI feature?***	
P11 FASTag issuance	Order and track an ICICI Bank FASTag (national toll-payment tag) in the app, paid via UPI.	Yes (FASTag)	PR, 1 April 2021
P12 Wallet auto top-up	A UPI e-mandate refills the PhonePe wallet automatically when it falls below a set level.	No	PR, 18 June 2021
P13 Flipkart cash-on-delivery via QR	Delivery agents show a dynamic QR so cash-on-delivery orders can be paid with any UPI app.	No	PR, 5 July 2021
P14 UPI AutoPay for mutual fund SIPs	Monthly mutual fund SIPs set up with a UPI AutoPay mandate.	Yes (UPI AutoPay)	PR, 2 August 2021
P15 BBPS ClickPay	Pay recurring bills through a biller-sent Bharat BillPay link.	Yes (Bharat BillPay ClickPay)	PR, 12 October 2021
P16 SafeCard tokenization	Card tokenization for online payments, to comply with RBI rules on saved cards.	No	PR, 2 November 2021
2022			
NPCI		***Compete with PhonePe feature?***	
N22 UPI 123Pay†	UPI for feature phones.	No	OC 115A; OC 209
N23 UPI ATM (card-less cash withdrawal)†	Withdraw cash at ATMs by scanning a QR code with a UPI app.	Yes (PhonePe ATM)	OC 150
N24 UPI Plug-in	Merchants embed a bank's UPI SDK in their own app for checkout.	Yes (PhonePe checkout)	OC 154
N25 UPI Lite†	On-device wallet for fast, PIN-less small payments.	Yes (PhonePe wallet)	OC 138
N26 RuPay credit card on UPI†	Link a RuPay credit card to a UPI ID.	No	RuPay circular NPCI/2022-23/RuPay/019-A; OC 171
PhonePe		***Rollout of NPCI feature?***	
P17 SmartSpeaker	Speaker that announces payments received at shops in 11 languages.	No	PR, 4 Aug 2022
P18 UPI online dispute resolution	In-app complaint and dispute handling through NPCI's UDIR system.	Yes (UDIR / UPI Help; OC 98)	PR, 13 Oct 2022

Feature	Description	Type	Source
P19 Aadhaar-based UPI activation	Set a UPI PIN with Aadhaar OTP instead of a debit card; first third-party app to do so.	Yes (Aadhaar OTP onboarding; OC 116)	PR, 9 Nov 2022
2023			
NPCI		***Compete with PhonePe feature?***	
N27 Credit line on UPI†	Pre-sanctioned bank credit lines usable as a UPI funding account.	Yes (PhonePe credit offerings)	OC 171
N28 UPI Lite X†	Offline UPI payments over NFC with no internet connection.	No	OC 169A
N29 UPI Tap & Pay†	Pay by tapping an NFC-enabled QR code at the merchant.	No	OC 186
N30 Hello! UPI†	Voice-based UPI payments in Hindi and English.	No	OC 175
N31 CBDC–UPI interoperability	Digital rupee wallets can scan UPI QR codes.	No	OC 170
PhonePe		***Rollout of NPCI feature?***	
P20 Cross-border UPI	Indian users pay merchants abroad (UAE, Singapore, Nepal, Bhutan) with UPI.	Yes (UPI Global; OC 117)	PR, 7 Feb 2023
P21 Pincode on ONDC	Shopping app built on the government-backed Open Network for Digital Commerce.	No	PR, 4 Apr 2023
P22 UPI Lite	PIN-less small payments from an on-device UPI Lite balance.	Yes (UPI Lite; OC 138)	PR, 2 May 2023
P23 RuPay credit cards on UPI	Link RuPay credit cards to UPI and pay merchants with them.	Yes (RuPay credit card on UPI; RuPay OC 019A)	PR, 25 May 2023
P24 Account Aggregator	Consent-based sharing of bank statements and other financial data under RBI's AA framework.	No	PR, 6 Jun 2023
P25 Android POS (UPI and cards)	One device accepting UPI, debit and credit cards via tap, swipe, dip, and dynamic QR.	No	PR, 6 Jul 2023
P26 Income tax payment	Pay advance and self-assessment tax in the app by UPI or credit card.	No	PR, 24 Jul 2023
P27 SmartSpeaker celebrity voice	SmartSpeakers announce payments in a celebrity's voice.	No	PR, 4 Sep 2023
2024			
NPCI		***Compete with PhonePe feature?***	
N32 Single Block Multiple Debits	Block funds once and debit them several times as needed.	No	OC 200

Feature	Description	Type	Source
N33 UPI Circle†	Primary user lets up to five trusted secondary users pay from their account, fully or within limits.	No	OC 201
N34 Cash deposit via UPI	Deposit cash at cash deposit machines using UPI.	No	OC 204
N35 UPI Lite auto top-up	UPI Lite wallet refills automatically from the bank account.	Yes (PhonePe wallet auto top-up)	OC 205
PhonePe		***Rollout of NPCI feature?***	
P28 Credit line on UPI	Link a bank's pre-approved credit line to UPI and pay merchants with it.	Yes (Credit line on UPI; OC 171)	PR, 22 August 2024
P29 Bolt in-app checkout	Payment gateway checkout inside merchant apps with no redirect, using UPI Lite, wallets and vouchers.	No	PR, 28 August 2024
P30 NPS contributions	Pay into National Pension System accounts through Bharat Connect (BBPS).	Yes (Bharat Connect)	PR, 5 November 2024
2025			
NPCI		***Compete with PhonePe feature?***	
N36 Multi-signatory accounts	Joint and multi-signatory accounts can make UPI payments with multiple approvals.	No	OC 224
N37 Micro-ATM cash withdrawal at BC points	Withdraw cash via UPI at business-correspondent micro-ATMs.	Yes (PhonePe ATM)	OC 225
N38 Biometric and face authentication	Approve payments with fingerprint or face instead of a PIN; Aadhaar face authentication for PIN setup.	No	OC 226
N39 UPI HELP (AI assistant)	AI assistant for payments, mandates, and disputes.	Yes (PhonePe in-app support)	OC 227
N40 UPI Reserve Pay	Reserve part of a credit card or credit line for repeat purchases on apps.	No	OC 228
N41 IoT payments on UPI Circle	Connected devices (cars, glasses, TVs) pay as delegated UPI Circle users.	No	OC 201B
PhonePe		***Rollout of NPCI feature?***	
P31 Device tokenization	Tokenize debit and credit cards once in the app and use them across PhonePe and PG merchants.	No	PR, 17 February 2025
P32 UPI Circle	Primary users let trusted contacts pay from their account.	Yes (UPI Circle; OC 201)	PR, 15 April 2025

Feature	Description	Type	Source
P33 Made-in-India SmartSpeaker	Upgraded SmartSpeaker with 4G, fast charging, and longer battery life.	No	PR, 5 May 2025
P34 Udyam registration	End-to-end digital MSME (Udyam) registration for merchants, with SIDBI.	No	PR, 10 September 2025
P35 Tap to pay (Mastercard)	Mastercard holders pay in-store by tapping an NFC phone, in India and abroad.	No	PR, 29 September 2025
P36 SmartPOD	SmartSpeaker combined with card point-of-sale in one device.	No	PR, 7 October 2025
P37 PG device tokenization (Mastercard)	Save a Mastercard once in PhonePe and pay with one tap at any PhonePe merchant.	No	PR, 7 October 2025
P38 UPI AutoPay on RuPay credit cards	Subscription mandates (first with JioHotstar) charged to a RuPay credit card on UPI.	Yes (UPI AutoPay; RuPay credit card on UPI)	PR, 8 October 2025
P39 PhonePe Protect	Real-time alerts that warn users before paying numbers flagged as suspicious.	No	PR, 3 November 2025

Totals: NPCI, 41 new features, of which 10 compete with a PhonePe feature. PhonePe, 39 payment features, of which 13 are rollouts of an NPCI feature.

Notes: OC = NPCI UPI Operating Circular. NPCI features are grouped by the year of the first OC that mentions them. PR = PhonePe press release. PhonePe features are grouped by the year of the first press release (PR) that mentions them.

† Listed among UPI's features on NPCI's website for UPI, UPI Chalega (www.upichalega.com/feature-faq). These features can be viewed as particularly important.

Sources: Authors' compilation from NPCI UPI operating circulars (npci.org.in/circulars/upi) and PhonePe press releases (phonepe.com/press).

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