

# Layer 2: The Architecture of Open, Programmable Value Rails

## Introduction: Forging the Financial Arteries of a New Social Contract

The second layer of the Pyramid of Power, "Open, Programmable Value Rails," constitutes the economic engine of a new digital social contract.<sup>1</sup> It envisions the financial infrastructure necessary to empower individuals in a post-labor economy, where traditional mechanisms of value distribution like wages may be supplemented or replaced by novel flows such as universal basic income (UBI), data dividends, or peer-to-peer creative earnings. This layer is not a speculative future; it is a consolidation of existing, scaled deployments that are already reshaping national and global economies.<sup>1</sup> These rails are the financial arteries through which value—money, assets, and credits—can move as freely, transparently, and programmatically as information does on the internet.

The architecture of this new financial landscape is emerging along three distinct but increasingly convergent models. The first is the **Public Utility Model**, exemplified by state-led Instant Payment Systems (IPS) that are designed as digital public goods to foster competition and inclusion. The second is the **Sovereign Model**, represented by the global rise of Central Bank Digital Currencies (CBDCs), which are digital forms of fiat money issued directly by the state. The third is the **Parallel Model**, composed of privately issued stablecoins operating on global, permissionless blockchains, forming a de facto alternative to the traditional banking system.

This report will argue that the competition, co-existence, and interplay between these three models are defining the future of global finance. Together, they are creating a hybrid system that fundamentally reshapes the relationship between citizens, states, and the economy. By analyzing the design principles, governance structures, real-world impacts, and strategic implications of each model, this analysis provides a comprehensive blueprint of the foundational infrastructure for economic agency in the 21st century.

# **Section I: The Public Utility Model — Instant Payments as a National Infrastructure**

The most profound and immediate transformation in national payment systems has come from the implementation of instant payment systems designed as open, public utilities. These systems treat the ability to transact as a fundamental piece of national infrastructure, akin to roads or the internet, rather than a service to be monopolized by private networks. Two nations, India and Brazil, have emerged as global exemplars of this approach, demonstrating that a public utility model can achieve unprecedented scale, drive profound financial inclusion, and catalyze widespread economic innovation.

## **Deep Dive: India's Unified Payments Interface (UPI)**

### **Architectural Principles: An Open Platform for Innovation**

Launched in 2016, India's Unified Payments Interface (UPI) has become a cornerstone of the country's digital economy, engineered from the ground up as a public good.<sup>1</sup> Its success is rooted in a set of core architectural principles that prioritize openness and interoperability over the closed, proprietary models of traditional payment networks. UPI is built on an open, technology-agnostic architecture with standardized Application Programming Interfaces (APIs).<sup>1</sup> This design choice was revolutionary; it created a common language for payments that allowed any licensed entity to build services on top of the core infrastructure.

The result was an explosion of competition and innovation. Over 300 banks and dozens of third-party application providers (TPAPs), including global tech giants like Google (Google Pay) and domestic leaders like PhonePe, were able to plug into the UPI network and compete for users on a level playing field.<sup>1</sup> This interoperability is seamless: a user of any UPI-enabled app can instantly send money to a user of any other UPI app, breaking down the walled gardens that characterize many payment systems.<sup>1</sup>

The user experience is defined by radical simplicity. Transactions are initiated not with cumbersome bank account numbers and codes, but with simple identifiers like a mobile phone number, a virtual payment address (VPA), or by scanning a universal Quick Response (QR) code.<sup>1</sup> Perhaps the most critical design decision was the implementation of a zero-fee

policy for consumers, which eliminated the primary barrier to adoption for small-value transactions and fueled its viral growth.<sup>1</sup>

## **Governance and Growth: A Public-Private Partnership**

The governance of UPI is as innovative as its technology. It is operated by the National Payments Corporation of India (NPCI), a not-for-profit consortium of major banks, established under the guidance of the Reserve Bank of India (RBI), the country's central bank.<sup>1</sup> This quasi-public model combines the oversight and stability of the central bank with the dynamism and investment of the private sector.<sup>3</sup> The RBI sets the regulatory framework, while the NPCI manages the system's operations and technical standards, ensuring a balance between innovation, security, and financial stability.<sup>6</sup>

This model has powered staggering growth. From its launch in 2016, UPI's transaction volume grew exponentially, reaching over 15 billion transactions per month by late 2024.<sup>1</sup> By August 2025, the system was processing over 20 billion transactions monthly, equivalent to nearly 7,500 transactions every second.<sup>8</sup> With over 500 million active users, UPI has positioned India as the world's leader in real-time payments, accounting for nearly half of all global instant transactions.<sup>8</sup>

## **Socio-Economic Transformation: A Digital Foundation for an Economy**

The impact of UPI extends far beyond the convenience of digital payments; it has fundamentally re-engineered India's economic landscape. The system is credited with a monumental leap in financial inclusion, bringing millions of previously unbanked and underbanked citizens into the formal economy for the first time.<sup>1</sup> By linking a biometric national ID (Aadhaar) to a bank account and a mobile number (the "Jan Dhan-Aadhaar-Mobile" or JAM trinity), the government created a digital backbone that UPI could leverage to reach the entire population.<sup>14</sup>

UPI has become the default payment rail for India's burgeoning gig economy. Ride-share drivers, food delivery workers, and other informal laborers now receive dozens of small digital payments daily, formalizing their income streams and creating a verifiable financial history that can unlock access to credit and other services.<sup>1</sup> It has been a powerful catalyst for Micro, Small, and Medium Enterprises (MSMEs), which have historically been reliant on cash. The low-cost, easy-to-deploy QR code system has allowed millions of small merchants, from

street vendors to neighborhood shops, to accept digital payments without the need for expensive point-of-sale hardware, broadening their customer base and improving cash flow.<sup>12</sup> The system's data reveals its deep integration into the fabric of daily life: while UPI dominates transaction volumes, it accounts for a smaller share of total value, indicating a high prevalence of small-ticket, everyday purchases.<sup>3</sup>

## **Deep Dive: Brazil's Pix**

### **A Central Bank-Driven Revolution: A Strategy of Mandated Interoperability**

Launched in late 2020 by the Banco Central do Brasil (BCB), Pix represents a different, more centralized approach to building a public payment utility. Faced with a highly concentrated banking sector, high fees for electronic transfers, and a persistent reliance on cash, the BCB took on the role of direct developer, operator, and regulator of the new system.<sup>16</sup> This was a deliberate strategy to force change upon the market rather than waiting for it to evolve.

A pivotal strategic decision was to mandate the participation of all financial institutions with over 500,000 customer accounts.<sup>18</sup> This masterstroke instantly solved the "chicken-and-egg" problem that plagues new payment networks; by ensuring all major banks were part of the system from day one, it guaranteed a critical mass of users and created powerful network effects that drove rapid, widespread adoption.

### **Market Dominance and Design: Echoes of Success**

The results of this top-down strategy have been nothing short of revolutionary. Within just three years of its launch, Pix had reached 153 million individual users—roughly 75% of Brazil's population—and was handling 42 billion transactions annually by 2023.<sup>1</sup> By 2024, it had definitively become Brazil's most used payment method, surpassing cash, debit, and credit cards in transaction volume.<sup>1</sup>

The design of Pix consciously echoes the principles that made UPI successful. It is free for individuals and offered at a very low cost to merchants, fostering a highly competitive market among over 800 participating payment providers.<sup>1</sup> The user experience is built for simplicity,

relying on easy-to-remember aliases (like a phone number or email) and QR codes to initiate transfers, with a standardized interface across all provider apps to ensure a consistent user journey.<sup>1</sup>

**Societal Impact and Future Programmability: Beyond Payments**

Like UPI, Pix has had a profound societal impact. The BCB estimates that the system introduced over 70 million Brazilians to electronic payments for the first time, many of whom were previously reliant on cash.<sup>1</sup> This has not only advanced financial inclusion but has also had tangible effects on public safety. Early evidence suggests a correlation between Pix's adoption and a decrease in certain types of street crime, such as armed robberies, as fewer people carry physical cash.<sup>1</sup> However, the shift to digital has created new challenges, particularly a rise in online scams and fraud, prompting the BCB to implement security measures like user-set transaction limits and time delays for suspicious transfers.<sup>1</sup>

Looking ahead, the BCB is actively building upon the Pix infrastructure to create a more programmable financial system. New features like "Pix Automático" are being rolled out to handle recurring payments for subscriptions and bills.<sup>17</sup> More significantly, Pix is being designed to integrate with Drex, Brazil's wholesale CBDC project. This will allow for the execution of smart contracts and other complex financial operations, such as tokenized asset sales, to be settled instantly over the Pix rails, paving the way for a fully programmable economy.<sup>1</sup>

**Table 1: Comparative Analysis of Leading Instant Payment Systems (IPS)**

Metric	India (UPI)	Brazil (Pix)
Governance Model	Non-profit consortium (NPCI) under central bank (RBI) oversight	Central bank (BCB) is the direct developer, operator, and regulator
Fee Structure	Free for consumers; merchants pay a small, regulated fee	Free for consumers; very low, competitive fees for merchants
Key Architectural Feature	Open, standardized APIs	Centralized infrastructure

	allowing third-party app development	with mandated participation for large banks
<b>Adoption Rate</b>	500M+ users <sup>8</sup>	160M+ users (~76% of population) <sup>22</sup>
<b>Monthly Transaction Volume</b>	~20 billion (as of Aug 2025) <sup>9</sup>	~6 billion (as of Q4 2024) <sup>23</sup>
<b>Primary Policy Goal</b>	Financial inclusion, formalization of the economy, fostering fintech innovation	Increasing banking competition, reducing cash reliance, financial inclusion
<b>Data Sources</b>	<sup>1</sup>	

## Deeper Analysis and Strategic Implications

The parallel successes of UPI and Pix offer profound lessons about the construction of modern financial infrastructure. A closer examination reveals two critical strategic shifts that these systems represent for the future of money and finance.

First, the comparison between the Indian and Brazilian models demonstrates that while the path to creating digital public infrastructure can vary, the destination is defined by a common set of principles. India pursued a decentralized, consortium-based approach. The NPCI, a quasi-public entity, built the foundational rails, but the innovation in user-facing applications was deliberately left to a competitive market of private technology companies and banks.<sup>3</sup> This strategy was perfectly suited to India's vibrant and competitive tech sector. Brazil, facing a more concentrated and less dynamic banking oligopoly, opted for a centralized, state-directed approach. The BCB itself built and operated the system, using its regulatory power to mandate participation and enforce interoperability, thereby engineering competition from the top down.<sup>18</sup> The fact that both of these divergent governance models produced convergent outcomes—mass adoption, deepened financial inclusion, and market dominance—is highly instructive. It proves that the ultimate success of a public payment rail is not determined by a specific governance structure, but by a steadfast adherence to core design principles: an open architecture, seamless interoperability, zero or near-zero cost for consumers, and a radically simple user experience. This provides a flexible and powerful

playbook for other nations, allowing them to tailor their approach to local market conditions to achieve the same transformative result.

Second, the rise of UPI and Pix signals a fundamental unbundling of financial services and poses a structural threat to the business models of legacy payment networks like Visa and Mastercard. For decades, these networks built their dominance on proprietary technology and a fee-based model, profiting from the very act of moving money. UPI and Pix disrupt this paradigm by treating payments as a public utility—a low-cost, commoditized layer of the digital economy.<sup>1</sup> By driving the marginal cost of a transaction toward zero, they eliminate the lucrative interchange fees that have long sustained the card networks.<sup>3</sup> This forces a structural shift in the financial industry. The locus of value creation and profit moves away from those who control the payment rails and toward those who can build the most compelling value-added services

*on top of them.* Banks and fintech companies can no longer rely on payment fees as a primary revenue stream; they must now compete by offering superior user experiences, innovative financial products, and integrated services. This creates a more dynamic and competitive ecosystem for consumers but represents a long-term existential challenge for incumbent payment giants whose entire business model is predicated on network exclusivity and transaction tolls.

## **Section II: The Sovereign Model — The Rise of Central Bank Digital Currencies**

In parallel with the development of public instant payment systems, a second, more direct model of state-led financial innovation has emerged: the Central Bank Digital Currency (CBDC). A CBDC is a digital form of a country's fiat currency that is a direct liability of the central bank. This global movement represents a potential re-architecting of the monetary system, with central banks exploring how to issue sovereign money directly to the public in a digital-native format.

### **The Global CBDC Landscape: A Wave of Sovereign Innovation**

The exploration of CBDCs has become a global phenomenon. As of mid-2025, an overwhelming 137 countries, which collectively represent 98% of the world's GDP, are in some stage of exploring a CBDC.<sup>1</sup> This marks a dramatic acceleration from just 35 countries in 2020,

indicating a widespread recognition among monetary authorities that the nature of money is fundamentally changing.<sup>30</sup> The motivations driving this exploration are multifaceted and vary by economic context. Common goals include improving the efficiency of domestic and cross-border payments, promoting financial inclusion for unbanked populations, fostering competition in payments markets dominated by a few large firms, and responding to the rise of private digital assets like stablecoins and cryptocurrencies.<sup>30</sup>

The work is proceeding along two parallel tracks: wholesale CBDCs, designed for settling large-value transactions between financial institutions, and retail CBDCs, intended for use by the general public for everyday payments.<sup>33</sup> While retail projects often capture public attention, research and pilot programs for wholesale CBDCs are generally more advanced, particularly in developed economies, where they are seen as a way to make financial market infrastructure more efficient.<sup>33</sup>

Recognizing that the true potential of CBDCs may lie in streamlining international payments, a growing number of central banks are collaborating on cross-border projects. Initiatives like Project mBridge, which connects the central banks of China, the UAE, Thailand, and Hong Kong, are actively testing multi-CBDC platforms. These projects aim to create a more efficient alternative to the current correspondent banking system, which is often slow, costly, and opaque, by allowing international transactions to be settled directly in central bank money.<sup>1</sup>

## **Case Study: China's e-CNY — A Blueprint for Scale and Control**

China's digital yuan, or e-CNY, is the most advanced and scaled CBDC project in the world, offering a clear blueprint for how a major economy can integrate a digital currency into its financial system.

### **The Two-Tier Architecture and "Managed Anonymity"**

The e-CNY operates on a two-tier architecture. The People's Bank of China (PBoC) sits at the top (Tier 1), responsible for issuing the e-CNY and managing the underlying system. It distributes the digital currency to a group of authorized operators—including state-owned commercial banks and major technology firms like Ant Group (Alipay) and Tencent (WeChat Pay)—which constitute Tier 2. These operators are then responsible for distributing the e-CNY to the public and providing user-facing wallet services.<sup>35</sup> This model leverages the existing infrastructure and customer relationships of commercial players while keeping ultimate



control with the central bank.

A defining feature of the e-CNY is its approach to privacy, described as "managed anonymity" or "anonymity for small-value and traceability for high-value transactions".<sup>35</sup> The system is designed to allow for a degree of privacy for small, everyday transactions, similar to cash. However, for larger transactions, the system retains the ability to trace funds to combat money laundering, tax evasion, and other illicit activities. This represents a deliberate policy choice to balance the public's desire for privacy with the state's law enforcement and regulatory objectives.

### **Programmability in Practice: Smart Contracts and Policy Tools**

A key technical feature of the e-CNY is its support for programmability through smart contracts.<sup>35</sup> This allows for "conditional payments," where funds are automatically transferred only when certain pre-defined conditions are met. The PBoC has actively tested a wide range of use cases for this feature during its extensive pilot programs. Examples include the targeted distribution of government subsidies that can only be spent on specific goods or services, conditional business-to-business payments that execute automatically upon delivery of goods, and the integration of payments into public services like transportation, healthcare, and tax collection.<sup>36</sup>

### **Scale and Ambition: A National and International Strategy**

The scale of the e-CNY pilot is unparalleled. By June 2024, cumulative transactions had reached ¥7 trillion (approximately \$1 trillion), with over 260 million personal wallets having been opened in the early phases of the pilot, which now spans 17 provinces.<sup>1</sup> The strategic goals for the e-CNY are both domestic and international. Domestically, it aims to increase the efficiency of the retail payment system, provide a public backup to the dominant private payment platforms (Alipay and WeChat Pay), and enhance the state's ability to monitor economic activity.<sup>37</sup> Internationally, while Chinese officials have downplayed ambitions to challenge the US dollar's dominance, the e-CNY could facilitate the use of the renminbi in cross-border trade and investment, particularly among countries participating in the Belt and Road Initiative, thereby gradually increasing its global footprint.<sup>41</sup>

## Case Study: India's Digital Rupee (₹)

Following the success of UPI, India has embarked on its own CBDC journey with the digital rupee, or ₹, taking a cautious and phased approach to its development.

### Design and Pilot Progress: A Dual-Track Approach

The Reserve Bank of India is simultaneously piloting two forms of the digital rupee: a wholesale version (₹-W) for the interbank market and a retail version (₹-R) for the public.<sup>43</sup> The architecture of the two versions differs based on their intended use. The ₹-R is designed as a token-based system, meaning it functions like a digital bearer instrument, similar to a physical banknote, where possession of the token constitutes ownership.<sup>44</sup> This is intended to give it cash-like properties. The ₹-W, in contrast, is an account-based system, where transactions are recorded as transfers between accounts held at the central bank.

The retail pilot, launched in December 2022, has been gradually expanding. As of March 2025, it included 17 participating banks and had onboarded 6 million users and hundreds of thousands of merchants.<sup>46</sup> The total value of ₹ in circulation reached ₹10.16 billion (approximately \$122 million) by March 2025, a significant increase from the previous year, indicating growing momentum in the pilot phase.<sup>30</sup>

### Key Features and Goals: Complementing, Not Replacing

A central tenet of the RBI's strategy is that the ₹ should complement India's existing, highly efficient payment systems, particularly UPI, rather than replace them.<sup>45</sup> To justify its existence, the ₹ pilot is focused on testing unique features that UPI does not currently offer. Chief among these are offline functionality and programmability.<sup>45</sup> The ability to conduct transactions in areas with limited or no internet connectivity is seen as a crucial feature for enhancing financial inclusion in remote and rural parts of India.<sup>45</sup> Similarly, the programmability feature is being explored for targeted payments, such as ensuring that direct benefit transfers to farmers are used for specific agricultural inputs, thereby reducing leakage and improving the efficacy of government welfare schemes.<sup>47</sup>

## **Case Study: The First Movers — Lessons from the Bahamas and Nigeria**

The world's first fully launched retail CBDCs in the Bahamas and Nigeria offer critical real-world lessons on the motivations behind and the challenges facing sovereign digital currencies.

### **The Sand Dollar (Bahamas): A Solution for Inclusion and Resilience**

The Bahamas launched the Sand Dollar in October 2020, becoming the first country in the world to roll out a nationwide CBDC.<sup>51</sup> The primary motivation was not technological novelty but a practical response to the country's unique geography and vulnerabilities. As an archipelago of over 700 islands, the physical distribution and management of cash is exceptionally costly and inefficient.<sup>51</sup> Furthermore, the nation is highly susceptible to natural disasters like hurricanes, which can severely disrupt traditional banking services and access to cash.<sup>51</sup>

The Sand Dollar was designed to address these challenges directly. Its key policy goals are to improve financial inclusion for residents in remote "Family Islands" with limited access to bank branches and to create a more resilient payment system that can function even when physical infrastructure is compromised.<sup>53</sup> A central feature of its design is a tiered wallet system. Tier 1 wallets have low holding limits (\$500) and do not require government-issued ID for enrollment, lowering the barrier to entry for unbanked individuals and satisfying simplified Know Your Customer (KYC) requirements.<sup>51</sup> This demonstrates a clear focus on maximizing financial inclusion.

### **The eNaira (Nigeria): A Study in the Challenges of Adoption**

Nigeria launched its CBDC, the eNaira, in October 2021, with ambitious goals of increasing financial inclusion, reducing the cost of remittances, formalizing its large informal economy, and providing a sovereign alternative to the growing popularity of private cryptocurrencies.<sup>32</sup> The eNaira operates on a two-tier model using a permissioned distributed ledger technology (DLT).<sup>32</sup>

Despite its early launch and the backing of the Central Bank of Nigeria (CBN), the eNaira has

struggled with persistently low adoption rates.<sup>61</sup> Several factors have contributed to this challenge. The user onboarding process was initially reported to be cumbersome and difficult to navigate.<sup>63</sup> For the majority of Nigerians who already had access to a range of mobile money and digital banking options, the eNaira offered few compelling advantages in terms of user experience or functionality.<sup>65</sup> Perhaps most critically, the launch was preceded by a government crackdown on private cryptocurrencies, which created a deep sense of mistrust among the tech-savvy population that would have been its natural early adopters. The eNaira was perceived by many not as an innovation but as a tool of state control, leading to a "failure of branding and mixed messaging".<sup>61</sup>

**Table 2: Global Retail CBDC Pilot/Launch Comparison**

Metric	China (e-CNY)	India (e₹-R)	Bahamas (Sand Dollar)	Nigeria (eNaira)
<b>Status</b>	Advanced Pilot	Pilot	Launched	Launched
<b>Stated Policy Goals</b>	Payment efficiency, competition with private platforms, monetary control	Complement UPI, financial inclusion, offline payments	Financial inclusion, disaster resilience, payment efficiency	Financial inclusion, lower remittance costs, formalize economy
<b>Architecture</b>	Conventional (centralized)	DLT-based (Token)	DLT-based	DLT-based (Permissioned)
<b>Privacy Model</b>	Managed Anonymity (traceable high-value)	Under pilot testing; aims for cash-like anonymity	Non-anonymous (fully auditable trail)	Non-anonymous (requires BVN/NIN)
<b>Offline Capability</b>	Yes (in pilot)	Yes (in pilot)	Yes (with pre-set limits)	Planned
<b>Distribution Model</b>	Two-tier (PBoC to	Two-tier (RBI to banks)	Two-tier with tiered wallets	Two-tier with tiered wallets

	operators)		(simplified KYC for Tier 1)	(based on KYC level)
<b>Key Adoption Factor</b>	Integration with public services and major tech platforms	Interoperability with UPI; unique offline/programmable features	Solving a clear need for unbanked in remote islands	Low adoption due to poor UX, lack of trust, and no clear user benefit
<b>Data Sources</b>	<sup>1</sup>			

## Deeper Analysis and Strategic Implications

The first wave of CBDC experiments provides critical insights into the opportunities and pitfalls of sovereign digital money. A deeper analysis reveals a fundamental strategic challenge that all retail CBDCs must overcome, as well as a paradigm-shifting capability that could redefine the nature of public policy.

The divergent experiences of Nigeria, the Bahamas, and the ongoing pilots in India and China highlight what can be termed the "Adoption Trilemma" for retail CBDCs. To succeed, a retail CBDC must simultaneously (1) offer a compelling and unique user advantage over existing payment systems, (2) ensure robust security and engender public trust, and (3) achieve widespread accessibility and ease of use. A failure on any one of these fronts can severely cripple adoption. The eNaira in Nigeria falters because, for many users, it failed on the first and second points: it offered little tangible benefit over existing mobile money solutions while suffering from a significant trust deficit.<sup>63</sup> In contrast, India's e-rupee faces the challenge of competing with the hyper-efficient and ubiquitous UPI system. Its success will therefore hinge on its ability to deliver unique value propositions, such as true offline capability and sophisticated programmability, that UPI cannot easily replicate.<sup>45</sup> The Sand Dollar in the Bahamas found a niche by addressing the third point—accessibility—for a specific, underserved population in a challenging geographic context, making its primary value proposition about basic access rather than superior features.<sup>51</sup> This reveals that the path to successful CBDC adoption is highly context-dependent. In markets with mature digital payment ecosystems, CBDCs must be feature-rich innovators. In markets with significant inclusion gaps, they must be accessible and simple. The Nigerian case serves as a stark warning that even where a clear need for inclusion exists, a poor user experience and a failure to build trust can be fatal.

Beyond adoption, the programmability feature being actively tested in the e-CNY and e-rupee pilots represents a profound shift in the function of money and the implementation of public policy. This capability transforms currency from a passive medium of exchange into an active tool for enforcing policy rules at the point of transaction. For example, by encoding rules into the digital currency itself, a government can ensure that welfare payments are spent only on essential goods, that agricultural subsidies are used exclusively for fertilizer, or that stimulus funds expire after a certain date to encourage immediate spending.<sup>39</sup> This moves governance beyond mere payment efficiency and into the realm of "governance-at-the-protocol-level." While this offers the potential for unprecedented efficiency and a reduction in fraud and administrative overhead, it also raises fundamental questions about individual economic autonomy, surveillance, and social control. The debate over CBDCs will inevitably evolve from one of technical feasibility to a much deeper political and ethical discussion about the implications of embedding state policy directly into the monetary code. This makes the design of privacy features, such as the "managed anonymity" model of the e-CNY, a critical battleground in defining the balance of power between the citizen and the state in a digital age.<sup>35</sup>

## **Section III: The Parallel Model — Global Stablecoins as a Permissionless Value Rail**

While states develop public and sovereign payment rails, a third, parallel system has emerged and scaled at a breathtaking pace: privately issued stablecoins. These are digital tokens that operate on public blockchains and aim to maintain a stable value by being pegged to a fiat currency, most commonly the US dollar. They have become a de facto global value rail, driven not by government mandate but by raw user demand for a borderless, permissionless, and stable digital currency.

### **The "Digital Dollar" Phenomenon: Scale, Function, and User Demand**

USD-denominated stablecoins, primarily Tether (USDT) and USD Coin (USDC), have grown into a formidable financial network. With a combined circulating supply of over \$125 billion, they function as a 24/7 global settlement layer accessible to anyone with an internet connection and a crypto wallet.<sup>1</sup> This ecosystem operates entirely outside the traditional banking system, offering a private-sector alternative for storing and moving value across the

globe.<sup>1</sup>

Their most compelling use case has emerged in countries plagued by economic instability and high inflation. In nations like Argentina, which faced inflation rates exceeding 100% in 2024, and Venezuela, stablecoins are not treated as speculative investments but as essential tools for survival and wealth preservation.<sup>1</sup> Citizens, facing the rapid devaluation of their local currencies, flock to USD-pegged stablecoins to safeguard their savings. This phenomenon, a form of "bottom-up digital dollarization," is driven by a desperate need for stability that the formal financial system cannot provide.<sup>67</sup> In Argentina, the demand is so strong that stablecoins now account for over 60% of all on-chain retail crypto transaction volume, far surpassing Bitcoin or other volatile assets.<sup>71</sup>

## **Disrupting Cross-Border Payments: A Faster, Cheaper Alternative**

Beyond serving as a store of value, stablecoins are fundamentally disrupting the multi-trillion-dollar market for cross-border payments and remittances. Traditional international transfers are notoriously slow and expensive, often taking several business days to settle and incurring fees that can exceed 5-10% of the transaction value, particularly for corridors serving emerging markets.<sup>73</sup>

Stablecoins offer a radically more efficient alternative. By leveraging public blockchains, they can bypass the complex web of correspondent banks that underpin the legacy system. A transfer of USDT or USDC from a sender in the US to a recipient in Nigeria can be settled in minutes, at any time of day, for a transaction fee that is often less than a dollar, regardless of the amount being sent. This can represent a cost reduction of up to 95% compared to traditional remittance channels.<sup>1</sup> This efficiency gain is a primary driver of stablecoin adoption in regions like Latin America and Africa, where remittances are a vital economic lifeline for millions of families and where businesses rely on cross-border commerce.<sup>76</sup>

## **The Coming Regulation: From Wild West to Walled Garden?**

The explosive growth and systemic importance of stablecoins have, unsurprisingly, attracted intense scrutiny from global regulators. The primary concerns revolve around ensuring financial stability (by mandating adequate reserves), protecting consumers from issuer failure, and preventing the use of stablecoins for illicit finance.<sup>79</sup> This has led to a global push to

create comprehensive regulatory frameworks.

The European Union has taken the lead with its landmark Markets in Crypto-Assets (MiCA) regulation, which came into force in 2023.<sup>82</sup> MiCA establishes a stringent regime for stablecoin issuers, requiring them to maintain 1:1 reserves in highly liquid assets, grant holders an absolute right of redemption, and adhere to strict governance and reporting standards. The framework effectively bans the issuance of unbacked algorithmic stablecoins, which were responsible for the market turmoil of 2022.<sup>83</sup>

In the United States, after years of regulatory uncertainty, a bipartisan consensus is forming. The Guiding and Establishing National Innovation for US Stablecoins (GENIUS) Act of 2025 creates the first federal framework for payment stablecoins. It mandates that issuers be regulated as financial institutions at either the state or federal level and requires that all stablecoins be backed 100% by cash or short-term U.S. government securities.<sup>83</sup> This move toward regulatory clarity is expected to pave the way for greater adoption of stablecoins by traditional financial institutions and corporations, integrating them more deeply into the mainstream financial system.

## Deeper Analysis and Strategic Implications

The organic, user-driven rise of stablecoins offers a powerful counter-narrative to the state-led development of CBDCs and reveals crucial dynamics about the future of money and geopolitical power.

First, while CBDCs are often framed as a potential challenge to the dominance of the US dollar, the rise of a regulated stablecoin ecosystem may paradoxically be the most powerful force for entrenching it. The logic is straightforward: the overwhelming majority of stablecoin value and usage is pegged to the US dollar.<sup>1</sup> Their primary function in emerging markets is to provide access to a digital version of the dollar.<sup>67</sup> New regulations in the US and EU mandate that these stablecoins be fully backed by high-quality, liquid assets—namely, US dollars held in bank accounts or US Treasury bills.<sup>85</sup> Consequently, every dollar, peso, or naira that is converted into a regulated stablecoin like USDC creates a corresponding demand for a US dollar or a US government bond to be held in reserve. This creates a massive, decentralized, and global demand for US sovereign assets, effectively outsourcing the expansion of the dollar's financial footprint to the private sector. The geopolitical implication is profound: the primary contest for currency dominance in the digital age may not be a direct battle between a Chinese e-CNY and a hypothetical US "digital dollar" CBDC, but rather between the e-CNY and a globally adopted, privately issued, but US-regulated, digital dollar stablecoin ecosystem.



Second, the explosive growth of stablecoins provides a powerful lesson in technology adoption: user demand is a far more potent force than government supply. One must only contrast the organic, bottom-up adoption of stablecoins in Argentina—where they solve the immediate and painful problem of hyperinflation—with the top-down, centrally pushed eNaira in Nigeria, which has struggled to gain traction because it failed to solve a clear problem for most of its target users.<sup>62</sup> This demonstrates that the success of any new value rail is ultimately determined by its ability to address a tangible, real-world need. Stablecoins have succeeded where some CBDCs have faltered because their value proposition is not an abstract concept like "payment efficiency" but a concrete solution to pressing financial challenges like wealth preservation and affordable remittances. This suggests that policymakers engaged in designing CBDCs must shift their focus from purely technical or macroeconomic goals to an intense, user-centric understanding of the specific "jobs to be done" for their populations. Without a clear and compelling answer to the question "What problem does this solve for me?", even the most technologically advanced sovereign currency risks becoming a pristine piece of infrastructure that nobody uses.

## Section IV: Synthesis and Strategic Implications

The emergence of three distinct yet overlapping models for digital value transfer—public utility IPS, sovereign CBDCs, and private stablecoins—is creating a new, complex, and dynamic global financial architecture. Understanding their comparative strengths, the synergies and tensions between them, and the overarching challenges they present is crucial for navigating the future of the economy and the social contract.

### Comparative Framework: Three Models of Value Transfer

The strategic differences between the three models can be best understood by comparing them across a set of key vectors. Each model represents a different set of trade-offs between centralization and decentralization, control and accessibility, and privacy and oversight.

Table 3: Strategic Framework for Value Rail Models

Metric	Instant Payment	Central Bank Digital Currencies	Private Stablecoins
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	Systems (IPS)	(CBDCs)	
<b>Governance &amp; Control</b>	Public-Private Partnership or Direct Central Bank Control (National)	Direct Central Bank Control (Sovereign)	Private Corporate Issuers (Global, subject to regulation)
<b>Primary Use Case</b>	Domestic Retail Payments	Domestic Retail & Wholesale; Programmable Policy; Cross-Border	Cross-Border Remittances; Inflation Hedge; Crypto-Ecosystem Settlement
<b>Financial Inclusion Potential</b>	Very High (proven in India/Brazil)	High (especially with offline features and simplified KYC)	High (for those with internet access, bypasses traditional banks)
<b>Programmability</b>	Emerging (via APIs and CBDC integration)	High (native smart contract capability is a core design goal)	High (native to smart contract platforms like Ethereum)
<b>Privacy Level</b>	Moderate (transactions logged by regulated entities)	Low to Moderate (designed for traceability; "managed anonymity")	Variable (on-chain pseudonymity, but regulated issuers require KYC)
<b>Scalability</b>	Extremely High (proven at national scale)	High (in theory, but unproven at national scale outside of pilots)	High (proven on global blockchains, but can face congestion)
<b>Key Regulatory Framework</b>	National Payment System Regulations	Central Bank Acts; New CBDC-specific legislation	MiCA (EU), GENIUS Act (US), and emerging national frameworks

<b>Data Sources</b>	1		
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# The Programmability Imperative: From Payments to Protocols

The single most transformative feature shared across the more advanced iterations of these value rails is programmability. The ability to embed logic, conditions, and automated execution into the flow of value elevates Layer 2 from a mere payment system into a foundational protocol for a new type of governance.<sup>1</sup> This is the technical capacity that unlocks the potential of the higher layers of the Pyramid of Power. For Layer 3 (Radical Transparency), programmable money allows for the creation of on-chain, real-time auditable public budgets, where funds are algorithmically tagged and tracked from allocation to expenditure. For Layer 4 (Direct, Programmable Democracy), it provides the mechanism for novel funding models like quadratic funding, where matching funds can be automatically and transparently distributed based on the collective will of a community, as encoded in their small donations.<sup>1</sup>

## Synergies and Tensions: A Hybrid Future

The future financial system is unlikely to be dominated by a single model. Instead, a hybrid system is emerging, characterized by both synergy and tension between the different rails.

Synergies are already being actively explored. In India, the e-rupee is being designed for interoperability with UPI, which could create a powerful combination: the universal reach and user-friendliness of UPI paired with the unique sovereign features of a CBDC, like offline capability and programmability.<sup>49</sup> In Brazil, the Drex CBDC is being built to leverage the instant settlement finality of the Pix network, allowing complex smart contract operations to resolve on a trusted public rail.<sup>1</sup>

However, significant tensions also exist. The most prominent is the clash between the rise of private, global stablecoins and the principle of national monetary sovereignty. The "digital dollarization" seen in Latin America is a direct challenge to the ability of central banks to conduct independent monetary policy, a key motivation for many to launch their own CBDCs as a public, sovereign alternative.<sup>79</sup> The regulatory frameworks being erected for stablecoins are a direct response to this tension, an attempt by states to reassert control over the monetary system.

## Challenges and Mitigations: Navigating the Risks

The transition to a fully digital value system is not without significant risks that require careful mitigation.

- **Fraud and Security:** The real-time, irrevocable nature of these systems makes them attractive targets for criminals. The experience in Brazil with a surge in scams and kidnappings targeting Pix users demonstrates that technological deployment must be accompanied by robust security measures, such as transaction limits and fraud detection systems, as well as extensive public education campaigns.<sup>1</sup>
- **The Digital Divide:** A rapid shift away from cash risks leaving behind significant portions of the population, particularly the elderly, the poor, and those in rural areas with limited digital literacy or internet access. This makes the development of robust offline capabilities, as being piloted with the e-rupee and designed into the Sand Dollar, a critical feature for ensuring equitable access and true financial inclusion.<sup>1</sup>
- **Privacy vs. Surveillance:** The enhanced traceability of transactions on national IPS and, most acutely, on CBDC ledgers, creates a powerful new potential for state surveillance of financial and personal activity. This is arguably the most significant political challenge of the new financial architecture. Designing systems with strong privacy protections, such as the "managed anonymity" concept of the e-CNY or the potential for anonymity vouchers floated for a digital euro, will be a central battleground in defining the digital social contract.<sup>1</sup>

## Conclusion: Paving the Rails for a New Economic Paradigm

The global deployments of instant payment systems, central bank digital currencies, and stablecoins are no longer isolated experiments; they are the constituent parts of a new, foundational layer of global economic infrastructure. As outlined in the Pyramid of Power framework, these open, programmable value rails provide the essential economic agency for individuals to thrive in a world where the traditional social contract, based on stable, lifelong employment, is eroding.<sup>1</sup> By enabling value to be sent instantly, at near-zero cost, and with embedded logic, these systems empower new forms of work, community funding, and social support.

The analysis reveals a complex and evolving landscape where no single model holds a

monopoly. The public utility model of UPI and Pix has proven its ability to achieve unparalleled national scale and financial inclusion. The sovereign model of CBDCs offers the potential for new policy tools and ultimate settlement finality, but faces significant challenges in adoption and the critical question of privacy. The parallel model of stablecoins demonstrates the power of user-driven innovation to solve real-world problems, while simultaneously challenging the monetary authority of the state.

For policymakers, the path forward requires a nuanced strategy that embraces this multi-rail reality. The goal should not be to pick a single winner, but to foster an environment of healthy competition and interoperability between public, sovereign, and private systems. This involves establishing clear, principles-based regulations that protect consumers and ensure financial stability without stifling innovation. It requires a relentless focus on the end-user, ensuring that new systems solve tangible problems and are designed to be inclusive, accessible, and trustworthy.

Ultimately, a robust and multifaceted Layer 2 is the indispensable foundation upon which the higher aspirations of the Pyramid of Power can be built. By making the flow of value transparent, programmable, and accessible to all, these new financial arteries empower citizens to become active participants in their economy. They provide the tools to scrutinize public spending (Layer 3), to directly allocate resources through new democratic mechanisms (Layer 4), and to build a more adaptable, resilient, and equitable social contract for the digital age.

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