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Open, Programmable Value Rails: The Second Layer of the Pyramid of Power

Introduction

David Shapiro's *"Pyramid of Power"* framework posits foundational layers for a more equitable post-labor economy. The second layer of this pyramid – **Open, Programmable Value Rails** – refers to next-generation financial infrastructure that is open-access, interoperable, and allows monetary value to move *programmatically* (i.e. governed by software rules rather than solely by traditional intermediaries). In essence, this layer envisions payment systems and digital currencies as public **utility rails**: widely accessible networks over which money, credits, and other tokenized value can flow instantly, at near-zero cost, with logic and conditions embedded directly into transactions. This white paper provides a comprehensive review of real-world progress toward open programmable money systems, details the enabling technologies behind them, and analyzes their societal and governance implications. Throughout, we examine how these emerging value rails could redistribute economic power – expanding inclusion and individual agency while challenging entrenched financial gatekeepers.

Real-World Implementations of Next-Generation Payment Systems

A number of pioneering programs around the world are already building or piloting the "open, programmable value rails" concept. These range from state-backed instant payment networks to central bank digital currencies (CBDCs) to private stablecoin platforms. Below, we review prominent examples and their achievements:

- **India – Unified Payments Interface (UPI):** India's UPI is a mobile-centric instant payments network launched in 2016 that has become a poster child for an inclusive, API-driven national payment infrastructure. UPI allows any bank or approved third-party app to plug in and enable person-to-person (P2P) and person-to-merchant (P2M) transfers in real time. Its open, interoperable design (users can send money to any recipient via a virtual ID or QR code, regardless of provider) and zero-fee policy for consumers have led to explosive adoption. As of 2024, UPI was processing **over 15 billion transactions per month** [1]; by mid-2025 it reached **18 billion monthly transactions, accounting for 85% of all digital payment volume in India** [2]. Authorities explicitly frame UPI as **"digital public infrastructure"** and a tool for financial inclusion [3]. Indeed, UPI's ease of use (e.g. payments via mobile number proxies) and open access have brought hundreds of millions of new users into formal finance. It has "made rapid strides in India's financial inclusion" [3], with government data indicating that UPI now underpins the vast majority of daily transactions. Global tech firms (Google, Walmart/PhonePe, etc.) utilize UPI's APIs in their apps, demonstrating the power of a standard, open payment rail to crowd in innovation while remaining governed by public-interest rules.

- **Brazil – Pix Instant Payments:** Developed by the Central Bank of Brazil and launched in late 2020, **Pix** is another real-time payment system that has rapidly transformed a large economy. Pix was

designed as a public utility available 24/7 for instant transfers between any bank or fintech accounts. Critically, **the central bank mandated all major banks and e-money firms to participate from day one**, ensuring ubiquity [4] [5]. The result has been immediate network effects: by 2024, **Pix was used for over 76% of all payment transactions in Brazil** [6], eclipsing cash and cards. Pix is **free for consumers** and very low-cost for businesses, lowering barriers for merchants and undercutting expensive card networks [7] [8]. It also supports easy addressing (payments via phone number, email or taxpayer ID) and QR codes, making it accessible to the less tech-savvy [9]. Critically, Pix has *banked the unbanked*: the IMF found **over 50 million Brazilians (20% of the population) used digital banking for the first time thanks to Pix in its first year** [10]. By treating payments as a **public good** rather than a profit center, Brazil's central bank catalyzed an inclusive network that "serves everyone" [11] [12]. The Pix experience shows that when instant payment rails are universally accessible, affordable, and interoperable, they can rapidly democratize finance – small businesses can manage cash flow better, informal workers can receive money instantly, and families can transact without fees or delays [13] [14].

- **China – e-CNY Central Bank Digital Currency:** China is at the forefront of **retail CBDC** deployment with its digital yuan, known as **e-CNY**. Piloted in various cities since 2020, the e-CNY aims to digitize cash and enhance the state's monetary infrastructure. The project is massive in scale – by 2022 over 260 million individual wallets had been created [15]. However, **adoption by consumers has been relatively modest** so far, as private mobile payment giants (Alipay, WeChat Pay) already saturate the market. By end of 2021 only about 6 million users were regularly transacting with e-CNY, and roughly ¥13.6 billion e-CNY was in circulation – *<0.01% of China's cash in circulation* [15]. In response, authorities have ramped up incentives (e.g. lotteries and giveaways) and, importantly, **introduced programmability features to distinguish e-CNY from ordinary payment apps**. Recent pilots enabled **smart contract** functionality: for example, during 2023 Lunar New Year, local governments issued millions in e-CNY **"consumption vouchers"** that could *only be spent at designated small businesses*, using code to enforce the condition [16]. Other trials linked e-CNY wallets to *targeted lending* (e.g. cheap loans usable only for specific purposes) and tested automatic tax payments [17] [18]. The e-CNY system also explores offline payments (via NFC smartcards) and devices that transfer value without internet – innovations aimed at cash-like resilience [19]. On the flip side, China's digital currency raises civil liberty concerns: it is not anonymous. In fact, pilots have integrated it with facial recognition at point of sale, tying every transaction to an identity and enabling real-time surveillance. The PBoC touts "controlled anonymity," but in practice e-CNY can **"take immediate legal action"** against violations – e.g. automatically freeze funds if illicit activity is detected [20] [21]. This unprecedented level of control highlights both the power and the risks of programmable money when state authorities can set granular rules. China's e-CNY thus illustrates a *state-centric* model of programmable value rails – vastly improving convenience and policy reach, but at the potential cost of privacy and market role of private banks.

- **Singapore – PayNow and Cross-Border Links: PayNow** is Singapore's instant bank transfer system (launched 2017) that enables real-time fund transfers using just a mobile number or ID. It has near-universal adoption among banks and has extended to e-wallets as well. Singapore has been a leader in connecting such domestic rails internationally. In 2021, PayNow was linked with Thailand's PromptPay, creating one of the first cross-border instant payment corridors. In February 2023, Singapore and India launched the **PayNow–UPI linkage**, allowing users in each country to send money to the other *within under a minute* [22] [23]. This integration is groundbreaking: it is the world's first cross-border real-time payments linkage to use a **cloud-based scalable infrastructure and to**

include non-bank financial institutions as participants [24]. Initially, an Indian user can remit up to ~SGD 1,000/day to Singapore via UPI-PayNow [25], with currency conversion handled seamlessly in-app. Such linkages slash the cost and time of remittances (traditionally 5%+ fees and days of delay) [26] [27]. They also demonstrate the potential of connecting national "open rails" into an *interoperable mesh*. Singapore is pursuing additional links (e.g. with Malaysia's DuitNow), often in collaboration with the BIS's Project Nexus (discussed later). These efforts herald a future global network of instant payment systems, bypassing the old correspondent-banking and wire transfer routes in favor of **direct, API-based country-to-country transactions**.

- **Stablecoin Ecosystems (Global):** In the private sector, **stablecoins** – digital currencies typically pegged to fiat (like USD) – have emerged as open value transfer networks atop public blockchains. Stablecoins such as USD Tether (USDT), USD Coin (USDC), and others now collectively facilitate *trillions of dollars* in transactions, often far from the traditional banking system. In fact, by 2024 **the on-chain transaction volume of stablecoins reached $27.6 trillion for the year, surpassing the volumes processed by Visa and Mastercard** [28]. This astonishing figure reflects uses in cryptocurrency trading, *cross-border transfers*, and as a digital dollar substitute in countries with unstable currencies. For example, in regions like sub-Saharan Africa, **43% of crypto transaction volume is in stablecoins** (primarily USD-pegged coins), as people seek dollar stability and easier access to global commerce [29]. Even in the U.S., a 2023 study found **26% of remittance senders had used stablecoins** to send money abroad, attracted by lower fees and faster settlement [30]. These dollar stablecoins operate on *open networks* (Ethereum, Tron, Solana, etc.), meaning *anyone* with an internet connection and a crypto wallet can hold and transfer value globally, 24/7. Mainstream companies are now embracing this: for instance, **PayPal in 2023 launched PYUSD, a U.S. dollar stablecoin, and its international remittance arm Xoom is using PYUSD for cross-border payouts** to avoid dependence on "traditional banking hours" [31]. Similarly, JPMorgan has created **JPM Coin**, a permissioned bank-issued stablecoin used internally by corporate clients to move money instantaneously across borders. As of 2023, JPM Coin was handling **$1 billion in transactions daily**, with over $300 billion transacted in total since its 2019 launch [32] [33]. Stablecoin networks thus represent a parallel set of value rails, one largely built by the private sector using blockchain protocols. They offer *programmability* (via smart contracts), interoperability (any compliant wallet can transact with any stablecoin), and continuous operation. However, they also pose new risks (governance of the peg, regulatory uncertainty) and will be discussed later in context of sovereignty and regulation.

- **Other Notable Initiatives:** Many other countries and regions are developing open payment networks inspired by the above. The European Union, for example, has rolled out **SEPA Instant** credit transfers (instantly clearing euro payments across 36 countries). The EU is also deepening **open banking** via PSD2 regulations, which require banks to provide APIs to fintechs for payments and data – effectively opening up the rails of account money to third-party innovation. In Africa, mobile money systems like **M-Pesa** in Kenya (while not fully open or public-domain) demonstrated how phone-based e-money can massively increase inclusion. More recently, open-source platforms like **Mojaloop** (backed by the Gates Foundation) provide reference software for instant payment switches in developing markets, aiming to replicate the success of UPI/Pix at lower cost. On the CBDC front, countries from Nigeria (eNaira) to the Bahamas (Sand Dollar) to Sweden (e-Krona pilot) are testing retail digital currencies, while consortia of central banks have trialed **wholesale** CBDCs for interbank settlement (e.g. Project Dunbar, Project Jura). The trajectory is clear: around the world, momentum is building toward treating fast, low-cost electronic payments as a **public utility**.

Whether through state-led platforms (Pix, UPI), public-private collaboration (FedNow in the U.S.), or private crypto networks (stablecoins, Bitcoin's Lightning Network), the legacy barriers in payments – slow batch processes, high fees, closed networks – are being dismantled. The next section examines the technical underpinnings enabling this revolution in value transfer.

Enabling Technologies for Programmable Money

Behind these real-world implementations are a suite of technologies and standards that make instant, programmable digital payments possible. We outline the key technical components and frameworks below, from payment protocols to smart contracts and digital currency architectures:

- **Instant Payment Protocols and Interoperability:** A fundamental enabling tech for open value transfer is the *real-time payment (RTP) system*. Over 70 countries now have domestic instant payment systems that clear transactions in seconds at near-zero cost [34]. These systems typically use modern messaging standards (such as **ISO 20022**) and run on 24/7 core banking infrastructure or distributed networks to achieve immediate settlement. Ensuring **interoperability** – both within a country (across banks and fintechs) and across borders – is crucial. Standardized interfaces (open APIs) and message formats allow different providers to plug into a shared rail. For cross-border, the Bank for International Settlements' **Project Nexus** exemplifies an interoperability layer: rather than each country making ad-hoc connections, Nexus proposes a hub or "gateway" that each national system can connect to once, enabling any-to-any instant payments globally [35]. A successful proof-of-concept linked the Eurozone's TARGET Instant Payment Settlement with Malaysia's and Singapore's systems in 2022 [36]. Now, central banks in five ASEAN countries are working toward a production Nexus scheme based in Singapore [37]. **Within 60 seconds**, a person in, say, Thailand could send money to someone in Europe, with currency conversion in-app and compliance checks automated. Key to such schemes are *common standards* – Nexus publishes detailed implementation guides, ISO 20022 message schemas and API specifications to ensure scalability as new countries join [38]. In summary, instant payment protocols plus interoperability standards form the *base layer*, replacing batch ACH and correspondent banking with an Internet-like network for money.

- **Smart Contracts and Programmable Disbursement:** Smart contracts are self-executing programs that run on blockchain or distributed ledgers, enabling **conditional and automated value transfers**. They are a linchpin of "programmable money" – allowing complex financial logic to be encoded in transactions. For example, on Ethereum one can program a contract to release funds to a supplier **only when a delivery is confirmed**, or to stream micropayments by the second for a subscription service. Governments and enterprises are leveraging this capability for more efficient disbursements. A notable case is China's e-CNY pilots where **smart contracts were used to issue subsidies as e-vouchers spendable only at certain merchants** (e.g. a city giving out ¥200 in digital currency that only works at local food stalls) [16]. This ensures stimulus money supports targeted sectors. In the private sector, JPMorgan's corporate blockchain platform has introduced **"programmable payments"** for its JPM Coin: clients can now set payments to execute automatically once specified criteria are met (say, a payment triggers when an invoice's due date arrives and goods have been received), removing the need for manual scheduling [39]. Decentralized finance (DeFi) offers even more examples: algorithmic **escrow contracts**, peer-to-peer lending protocols, and automated market makers all run via smart contracts that hold and transfer funds based on coded rules. Furthermore, entire **disbursement frameworks** can be built – e.g. consider a relief organization issuing aid through a smart contract that splits funds among recipients and tracks

usage, or a *quadratic funding* pool on Ethereum that automatically matches individual contributions to public projects according to a formula. These innovations are made possible by the underlying blockchain platforms (Ethereum, Solana, etc.) that support Turing-complete scripting for financial applications. In summary, smart contracts dramatically expand the functionality of money by making it *conditional, event-driven, and transparent*. They enable a shift from static payments to **"if-this-then-that"** programmable transactions, laying the groundwork for autonomous economic agents (like DAOs) and automated financial services.

- **Blockchain Settlement Networks:** Distributed ledger networks (blockchains) provide a global, decentralized backbone for transferring and settling digital assets. They are critical to open value rails in two main ways: **public blockchain networks** (like Bitcoin, Ethereum) create an open, permissionless environment where anyone can transact or deploy financial code; and **permissioned blockchain networks** (consortia or enterprise DLTs) allow known institutions to transact directly without centralized clearinghouses. Public blockchains have already demonstrated new settlement paradigms: e.g. billions of dollars of stablecoins move daily on Ethereum and Tron, settling within minutes on-chain and available to recipients immediately, regardless of borders. Bitcoin's **Lightning Network** (a layer-2 for instant Bitcoin payments) allows users to send value peer-to-peer with nearly zero fees by using smart channels – expanding Bitcoin's utility for small payments. On the enterprise side, major banks have built private blockchain rails: **JPMorgan's Onyx/Kinexys platform**, for instance, uses a variant of Ethereum to let corporate and bank clients settle inter-company payments 24/7. It has processed over **$1.5 trillion in notional value** since launch and routinely handles ~$1 billion per day via JPM Coin transfers [40] [32]. Settlement finality is achieved in seconds on the ledger, instead of waiting for wire cut-off times. Another striking example is the multi-central-bank pilots for cross-currency settlement. In 2022, the **mBridge** project (BIS Innovation Hub with Hong Kong, Thailand, UAE, and PBoC) piloted a shared DLT platform where commercial banks in each jurisdiction used tokenized central bank money to swap currencies. Over a six-week pilot, 20 banks conducted 164 FX payment transactions totaling $22 million, *settled directly on the platform* without correspondent banks [41] [42]. The test proved that a blockchain multi-CBDC network can enable **peer-to-peer atomic settlement** across countries, potentially reducing costs and inclusion gaps in global transfers [43] [44]. Whether public or private, these blockchain-based networks are inherently programmable and run continuously, giving them advantages over legacy RTGS systems. They do face challenges (scalability, energy usage in some cases, legal questions about finality), but ongoing innovations (like proof-of-stake consensus, layer-2 scaling, and interoperability protocols) are rapidly maturing the technology. In summary, blockchain networks furnish the **distributed trust layer** for open value rails – allowing parties who don't know each other (or banks across different regulators) to transact with certainty by relying on cryptographic consensus rather than centralized ledgers.

- **CBDC Architectures and Digital Currency Platforms:** Central Bank Digital Currencies are a special case of programmable value rail, involving a digital form of sovereign fiat currency. Various architectures are being explored globally. A common model for **retail CBDC** is the **two-tier architecture**: the central bank issues digital currency to intermediaries (banks or payment service providers), who then distribute it to end-users and handle KYC/UX, much as with cash today. This preserves the existing financial system roles while extending central bank money to the public in digital form. For example, **Nigeria's eNaira CBDC uses a two-tier model** – the Central Bank of Nigeria creates eNaira, but commercial banks and fintechs manage the wallets for individuals and businesses [45]. Most advanced retail CBDC projects (China, Eastern Caribbean, etc.) similarly

leverage private-sector onboarding to achieve scale. Another design dimension is **token-based vs account-based**: token CBDCs (like a digital banknote) can be transferred peer-to-peer with digital signatures, potentially offline; account-based designs resemble bank accounts at the central bank. In practice, hybrids are emerging – e.g. one might hold a tokenized e-Cash locally, but still require an account for recovery or large holdings. Central banks are also grappling with **privacy and identity**: how to allow some degree of anonymity for small payments (to mimic cash and allay surveillance fears) while still preventing illicit use. The ECB has suggested a digital euro could have *anonymous offline functionality up to a limit*, and beyond that, transactions would be transparent to regulators [46] [47]. On the programmability front, many CBDC prototypes incorporate some smart contract capability – often in a cautious way ("scriptable" money with central bank-approved libraries, or a tiered architecture where external logic can trigger payments without altering the core ledger). China's e-CNY, as noted, is experimenting with **expiration dates and spending restrictions coded into money** (e.g. stimulus funds that *vanish if not spent by date X*, forcing velocity) [18]. This is a double-edged sword technically and politically. CBDC platforms like the one Riksbank tested (on Corda DLT) or the Bahamas Sand Dollar (on custom centralized infrastructure) are also pioneering offline transfer solutions (smart cards, mobile wallets that sync later). In sum, CBDCs represent a major new technology for value transfer, effectively *upgrading sovereign currency for the digital age*. Their architecture choices – centralized ledger or distributed, direct issuance or two-tier, degree of programmability and data access – will significantly influence how empowering or controlling they are. What's clear is that the mere possibility of CBDCs is driving innovation: even before wide deployment, their prospect has pushed improvements in existing payment systems (as central banks "feel the heat" from crypto and move to modernize fiat rails).

- **Open APIs and Token Standards:** A subtler but vital enabler of programmable finance is the use of **standardized APIs and token standards**. These ensure different systems and applications can talk to each other and handle the same units of value. In traditional banking, open API initiatives (often spurred by regulation like PSD2 in Europe) have broken the monopoly of banks over account data and payments. Via secure APIs, fintech apps can initiate payments or retrieve account info on behalf of users – effectively *programming the bank* to move money with user consent. This has given rise to "overlay" services (budgeting apps, automated savings, etc.) that sit atop the basic rails. In the blockchain world, **token standards** are akin to open APIs for value. The ERC-20 standard on Ethereum, for instance, defines a common interface for fungible tokens. This uniformity means any ERC-20 token (whether it represents a stablecoin, a loyalty point, etc.) can be accepted by any Ethereum wallet or integrated into any smart contract that supports the standard. Such **composability** is crucial to building an open financial ecosystem – it's why you can, say, use Uniswap or Aave with dozens of different tokens seamlessly. Newer standards continue to expand functionality. For example, **ERC-4626**, the *Tokenized Vault Standard*, was introduced in 2022–2023 to standardize yield-bearing tokens (like shares in a lending pool or interest-bearing deposit) [48]. Each ERC-4626 token represents a claim on an underlying asset plus yield, and the standard provides a unified API for depositing, withdrawing, and accounting for yields. This makes it far easier for DeFi applications to integrate various yield-generating instruments without custom code for each [49] [50]. In essence, ERC-4626 extends ERC-20 by defining how interest-bearing vaults report balances and accept assets, enabling *plug-and-play interoperability* across protocols. Beyond Ethereum, similar token or asset standards exist in other environments (e.g. ISO 20022 defines data models for fiat payment messages; central banks are considering standard "token templates" for CBDCs; even NFTs have standards like ERC-721). The broader point is that open standards and APIs **lower integration costs** and prevent vendor lock-in. They ensure that new entrants – whether an indie developer

building a payments app or a local community issuing a token – can operate on the same rails as incumbents. This fosters a more **competitive and innovative environment**, where value can flow freely and be accessed through multiple platforms. The "rails" become a commons (protocols available to all) rather than proprietary networks. In summary, technological standards for interoperability, from open banking APIs to blockchain token specs, are the unsung heroes enabling a truly programmable *and* inclusive financial system.

Societal Impacts: Inclusion, Empowerment, and Economic Transformation

If open, programmable value rails become the norm, the societal ramifications will be profound. Such rails could fundamentally **democratize economic participation**, reduce inequalities perpetuated by the legacy financial system, and support novel mechanisms for collective welfare and human flourishing. Here we analyze key impacts:

- **Financial Inclusion and Access:** Perhaps the most direct benefit seen so far is bringing previously excluded populations into the formal economy. When payment and savings services are available to anyone with a mobile phone (and at negligible cost), traditional barriers – like needing a bank branch or minimum balance – fall away. India's UPI and Brazil's Pix both drastically lowered the threshold for participation, resulting in tens of millions of unbanked people gaining access within a short time [10] [3]. Inclusive digital rails mean a street vendor can accept non-cash payments; a migrant worker can send money home instantly; a smallholder farmer can receive a microloan disbursement to a wallet. This **boosts economic participation** from the ground up. Notably, these systems also tend to have high **gender inclusion** (since women, who are often excluded from banking, can access mobile payments if they have a phone). By design, open systems also allow a broader range of service providers to reach people – for example, in Africa telecom-operated mobile money filled the gap where banks wouldn't go, and now fintech startups use open APIs to offer innovative services on top of UPI/Pix. Inclusion is not only about individuals but also small businesses and rural communities. Digital public infrastructure enables low-cost merchant payments and access to credit based on transaction history, etc., empowering micro-entrepreneurs. In short, **programmable value networks can bake inclusion into their design**, treating it as a priority rather than a CSR afterthought [11] [51]. Everyone benefits when more people are transacting formally: consumers have more choices, governments can better target aid, and the economy's velocity increases as fewer people are trapped in cash-only dead-ends.

- **Reducing Gatekeeping and Oligopoly Power:** Traditional finance has numerous chokepoints – large banks, card networks, money transfer operators – that have functioned as **gatekeepers**, extracting fees and often excluding or mistreating those with less power. Open value rails can *route around* these gatekeepers. For instance, a domestic instant payment grid obviates the need for every small payment to ride costly Visa/Mastercard rails (which **take a cut of every transaction and charge merchants fees** [52]). Brazil explicitly saw Pix as a way to break the credit-card duopoly and push banks to innovate; indeed, Pix's popularity forced incumbents to cut fees and improved payment options for merchants. In Europe, the push for a **digital euro** and the EU's support of its own payment network (the **European Payments Initiative**) is driven by concern that **foreign card firms and Big Tech could otherwise dominate payments, posing sovereignty and competitive risks** [53] [52]. By providing a public, universal alternative, authorities aim to **limit the dominance of**

private intermediaries and keep the financial infrastructure under democratic oversight. On a more local level, open rails mean *any fintech or coop* with a good idea can build on the network (e.g. a budgeting app that hooks into bank APIs and helps customers avoid overdrafts, or a community mutual credit system that interoperates with the national system). This fosters competition and dilutes the monopoly power of big banks. It also reduces **"financial gatekeeping"** in the sense of arbitrary exclusion: if one bank denies you service, you could still use a CBDC wallet or a different provider on the same network. Similarly, censorship resistance can be enhanced – decentralized stablecoins or Bitcoin can allow transactions that a card company might block due to corporate policies. Of course, some gatekeeping (against fraud, crime) is necessary, but in an open system it can be implemented via transparent rules rather than proprietary whims. The net effect is a shift in **bargaining power** toward users. When a large share of payments flows through public-good platforms that don't exploit customers (Pix, UPI) or through decentralized networks, traditional players must either adapt or lose relevance. In Brazil, for example, Pix was free and instant – banks had to stop charging ~$10 for a same-day wire (TED transfer) because people rapidly switched to Pix. This **"democratization by infrastructure"** forces incumbents to compete on customer experience and value-added services rather than rent-seeking on basic access.

- **New Mechanisms for Redistribution and Public Good Funding:** Beyond inclusion, programmable money enables creative ways to **share wealth and fund social initiatives**. One much-discussed idea is **Universal Basic Income (UBI)** – a flat, unconditional payment to all individuals to provide a income floor in a post-labor economy. Implementing UBI through traditional means can be complex, but with CBDCs or digital wallets it becomes far more feasible to *automate recurring disbursements* at scale. For example, instead of a tangle of welfare programs, a government could credit every citizen's digital wallet with $1,000 each month in a single stroke. Smart contracts could adjust the amount based on inflation or other parameters. Crucially, the **administrative overhead drops** and fraud can be minimized (each person has a verified ID-wallet). UBI trials have already been conducted (Finland, Kenya, various U.S. cities) albeit without blockchain; integrating them with digital currency could enhance transparency and auditability of outcomes. Another novel concept is the **Data Dividend** – the idea that users should receive a share of the profits made from their personal data. California's Governor proposed that tech companies pay a "data dividend" to the public [54], effectively recognizing data as a collective asset. Programmable money could operationalize this by automatically aggregating payments from firms into citizen wallets (perhaps via a tax mechanism or direct micropayments for data usage). While the exact implementations are still being debated (and some argue for privacy laws instead of pay-for-data [55] [56]), the existence of an open value rail makes it *technically* much easier to distribute such dividends widely and frequently (even micro-dividends in real time if desired). Yet another mechanism enabled by programmability is **Quadratic Funding (QF)** for public goods. QF, pioneered by radical market theorists, uses a matching pool to **amplify small donations** – funds are allocated such that projects supported by many people get exponentially larger matches than those supported by only a few wealthy donors [57] [58]. This incentivizes broad participation in funding community goods. Platforms like Gitcoin have implemented QF on Ethereum to fund open-source projects, with smart contracts transparently distributing matching funds. This model could extend to city budgets or global philanthropy, leveraging digital ID to prevent abuse. The *common thread* is that programmable rails allow **direct, fine-grained, and rule-based redistribution** of money. Whether it's an equal per-capita grant (UBI), a proportional data revenue share, or a complex matching formula, these policies can be executed with low cost and high precision via software. This potentially unlocks new **social safety nets** and public investment models that are more responsive and decentralized. For instance, one could

imagine a “digital dividend” where profits from national resources or automation are regularly paid out to all citizens in token form (akin to Alaska’s oil dividend, but automated). Overall, programmable money gives governments and communities powerful new tools to address inequality and fund collective needs – if they choose to use them.

- **Economic Agency in a Post-Labor Society:** As AI and automation reduce the need for human labor, the economic system will need to adapt to keep individuals empowered. Programmable value rails can underpin that adaptation by **decoupling livelihood from formal employment**. If people can receive income through digital mechanisms (UBI, community currencies, gig-based micropayments, etc.), they are less at the mercy of the labor market for survival. This increases individual agency: one can reject an exploitative job if a baseline income is ensured, or pursue more creative and caregiving roles that are not high-paid but socially valuable, knowing that basic needs are met. By providing a *minimum income floor*, UBI strengthens workers’ bargaining power – effectively, each person has a “walk-away option” from bad employers, which could drive up standards for jobs that remain. Furthermore, programmable money can enable new forms of work and reward. For example, people could earn **“data labor” income** by voluntarily sharing data and getting paid via smart contract (some startups already explore this). Or someone could contribute to open-source software or climate monitoring and automatically receive micro-bounties or token rewards. In a post-labor scenario, **economic agency** might mean the freedom to define one’s contribution to society outside of a traditional job framework, yet still receive a share of economic output. Decentralized autonomous organizations (DAOs) hint at this future: individuals around the world collaborate on projects (like editing Wikipedia or improving open-source code) and get rewarded in tokens that have real value. With open value rails, these tokens can be readily converted or used, blurring the line between “work” and civic participation. Importantly, *time* becomes a currency as well. Thought leaders argue that as automation increases productivity, **dividends from AI and robotics should be distributed to citizens, effectively “giving humanity back their time”** [59]. This could fund more leisure, education, community work, or artistic pursuits – enriching quality of life. The social contract might shift from “you must work to deserve basic economic rights” to “you have economic rights by default, freeing you to pursue work that is fulfilling or socially beneficial.” Of course, this future raises big questions: who controls the platforms, how to ensure fair distribution, etc. Programmable money itself doesn’t guarantee a utopia, but it provides the *infrastructure* on which a new post-labor social contract could be built. By reducing dependency on wage labor for income (via UBI and dividends) and by enabling bottom-up economic initiatives (via co-ops, local currencies, and global peer production), open value rails **enhance individual and community agency**. People can have more say in how value is created and allocated, rather than being mere employees or consumers in systems run by distant capital owners. This ties directly into questions of governance and power, which we examine next.

Governance and Political Implications: Sovereignty, Surveillance, and the Commons

Programmable finance doesn't just have economic effects – it also has deep implications for power structures, governance models, and the relationship between citizens and the state (and big corporations). We consider several important dimensions of political economy and theory:

- **Monetary Sovereignty and Geopolitics:** Money is inherently tied to national sovereignty – states jealously guard their control over currency issuance and monetary policy. The advent of global stablecoins, foreign CBDCs, and cryptocurrency poses a challenge: if a country's citizens start using an alternative digital currency at scale, the national central bank could lose effectiveness. For instance, during Facebook's 2019 Libra proposal (a global stablecoin), regulators panicked that a private company's currency could erode central banks' monetary sovereignty. Today, U.S. dollar stablecoins are ubiquitous; if, say, Argentine or Nigerian citizens use USDC en masse to store value, their central banks have much less leeway to manage the local money supply or stabilize the economy. Europe is acutely aware of this – **officials note that dollar-backed digital currencies could circulate widely in the eurozone yet lie "beyond the ECB's direct influence," effectively creating a parallel currency managed by the U.S. Federal Reserve** [60]. This is seen as a strategic vulnerability. Thus, part of the motivation for a **digital euro** is to *preempt foreign or corporate digital monies* and **"safeguard monetary sovereignty in the digital age."** The ECB states that a digital euro is increasingly *essential* to ensure EU payments autonomy and to **provide a public, euro-denominated alternative to foreign payment systems and stablecoins** [61] [53]. Similarly, countries like India have banned private crypto while planning their own CBDC, partly to maintain sovereign control. On the other hand, some argue that *too much* sovereignty (in the sense of capital controls and opaque monetary policy) can be checked by open currencies like Bitcoin – giving citizens an exit option if their national currency is mismanaged. This dynamic is already visible in countries with high inflation or sanctions: people turn to crypto or stablecoins as an alternative store of value and payment rail, thereby weakening state power over finance. We may see new forms of "currency diplomacy" – for example, China might promote e-CNY use abroad to extend its influence (as the U.S. does with the dollar). Coalitions of smaller nations might adopt a shared digital currency to reduce dependence on major powers. In summary, programmable value rails bring *monetary sovereignty to the forefront*: states are striving to harness the technology (through CBDCs) to reinforce sovereignty, even as the technology simultaneously empowers transnational or private currencies that undermine that same sovereignty. The outcome will likely be a rebalancing – with central banks modernizing to remain relevant, and new multi-currency arrangements evolving (potentially even an IMF-backed digital SDR for global use, etc.). Importantly, monetary sovereignty isn't just a national issue; at the individual level, one could speak of **personal monetary sovereignty** – the ability to choose or create a currency. Crypto enthusiasts claim Bitcoin gives people sovereignty over their money (since no government can debase it arbitrarily). In an open-finance future, communities might have more say (via local currencies, complementary currencies) in defining what holds value for them, rather than accepting the monopoly of a distant central bank. This decentralization of monetary power is both exciting and unsettling to traditional authorities.

- **Surveillance and Privacy in a Cashless Society:** A major concern with digital finance is the potential for pervasive **financial surveillance**. Cash is anonymous; digital payments typically are not. Without deliberate privacy safeguards, programmable money could become a tool for authoritarian control

or corporate data mining. We already see this tension in China's e-CNY: while the PBoC insists that e-CNY offers "controlled anonymity" (identifying information is hidden except when requested by authorities), in practice many Chinese citizens fear government tracking of all transactions [62]. Their fears aren't unfounded – the pilot design links to digital ID and phone numbers, and Chinese cities are marrying the CBDC with facial recognition payment systems that, by design, **"put an end to the absolute anonymity of cash."** [20] The e-CNY system is reportedly built to allow *instant enforcement*: if law enforcement flags a user, the central bank can freeze that person's funds or reject transactions automatically [21]. This is a **financial panopticon** scenario. Even in democratic societies, a fully traceable digital currency raises concerns. Governments could monitor citizens' spending (violating privacy), or even program money with political conditions (imagine welfare dollars that cannot be spent on certain disfavored items, or a future regime that freezes the accounts of protesters). Thus, the design of open value rails must grapple with the trade-off between **transparency and privacy**. The technology does offer solutions: for instance, cryptographic techniques like **zero-knowledge proofs** can enable verification of transactions or identity attributes *without* revealing the actual data. The EU has indicated interest in using such techniques for a digital euro to allow anonymity for low-value transfers while still preventing abuse. Some advanced CBDC prototypes (e.g. by the Bank of England) propose *tiered privacy*: small transactions would not record identity, larger ones would. Policy and law also have a role – robust privacy laws and independent oversight can constrain how transaction data is used by both governments and businesses. Another aspect is **cybersecurity**: a centralized digital currency ledger may become a tempting target for hackers or mass surveillance by malicious actors, so ensuring strong encryption and resilience is paramount. It's worth noting that open, decentralized systems like Bitcoin provide a different model: pseudonymity. All transactions are public, but identities are not directly tied (unless revealed through off-chain info). Some newer protocols (Monero, Zcash) focus on built-in privacy for transactions. The lessons from these could inform public infrastructures. Ultimately, society will have to decide **how much financial privacy is a right**. The outcome will shape the power balance between state and citizen. Programmable rails could either **empower individuals** (with tools to protect privacy, like local storage of tokens, anonymous e-cash for small trades) or **empower surveillance regimes** (if every transaction leaves an indelible, accessible trail). This is a critical governance choice. Achieving the benefits of transparency (e.g. reducing corruption, tax evasion, and money crime) *without* creating an Orwellian money system will likely require both technical innovation and strong legal safeguards.

- **Programmable Welfare and Social Control:** The programmability of money also has implications for the **social contract** between governments and citizens. If state-distributed money (UBI, benefits, subsidies) comes with code-based conditions, it could either improve outcomes or become a new form of paternalistic control. For example, a government might program unemployment benefits to **only be spendable on essentials (food, housing)** and not on, say, alcohol or tobacco. This might indeed direct funds to their intended purpose, but it infringes on personal freedom and assumes the state knows best. Another scenario: a local stimulus might be coded to expire in three months if not spent, to force recipients to inject it into the economy quickly (China tested exactly this kind of "use-it-or-lose-it" voucher) [16] [18]. Again, this may boost consumption, but it removes the individual's choice to save that money. There is also a **fairness** question – would such conditions apply to all money, or only to those receiving assistance? If the latter, it could create a two-tiered monetary system where the poor have "constrained" digital dollars and the rich have free-use dollars. On the positive side, programmable welfare could make government support far more efficient and responsive. Policy tweaks could be implemented via smart contract updates rather than slow bureaucracy. During a pandemic downturn, an immediate increase in UBI or an automatic extension

of expiring benefits could be triggered by economic indicators coded into the system. Fraud and leakage could be reduced (funds only go to verified recipients and can't be misused for unauthorized purposes). There's also potential for **personalized policy**: benefits that adjust to one's circumstances (like more heating credit if a cold month and you live in a cold region, etc.), which can be done via IoT and data-driven contracts. All of this, however, raises the issue of **who writes the code**. If it's solely the central government with little transparency, then effectively social policy is being enforced by algorithms without democratic deliberation each time. Ideally, the rules embedded in money would be subject to public debate and review just as laws are. We may need new institutions – perhaps *"monetary commons"* committees that oversee how programmable features are implemented, to prevent overreach. This leads to the broader notion of treating financial infrastructure as a *common good*.

- **Financial Commons and Decentralized Governance (Ostrom's Principles):** The vision of open value rails aligns in many ways with **Elinor Ostrom's** theories on commons governance. She demonstrated that communities can sustainably manage shared resources (like fisheries, forests) through collective rules and monitoring, without requiring either privatization or top-down state control. One can analogize digital payment networks and currencies to a new kind of **commons** – a shared infrastructure or resource that many actors use and contribute to. Blockchain networks are a prime example: Bitcoin or Ethereum can be viewed as a *global commons for financial transactions and computation*. No single entity owns them; rather, participants (miners, node operators, developers, users) jointly uphold the network according to agreed protocols. Ostrom's principles (clearly defined community, rules matching local needs, collective decision-making, effective monitoring, graduated sanctions, conflict resolution, minimal recognition of rights) can be seen in the governance of some crypto networks and decentralized finance communities. For instance, many decentralized protocols have governance tokens and DAOs where stakeholders vote on rule changes – a form of **polycentric governance** similar to Ostrom's idea of self-governance at multiple scales. Researchers have explicitly drawn parallels, arguing that **blockchain networks represent "knowledge commons" governance, relying on collectively managed technology to pool and manage resources/ information** [63]. An open value rail for a nation (like UPI) can also be seen as a commons: it's infrastructure provided as a public good that all banks and fintechs use under agreed rules (the rules in this case set by NPCI/RBI in consultation with industry – not fully bottom-up, but a form of community governance among stakeholders). The **political theory implication** is a shift from purely centralized sovereign control or purely private ownership to a middle path – **the commons model** – for money and payments. If done right, this could increase resiliency (no single point of failure or coercion), and ensure the system serves the users' needs (since users have a voice in governance). For example, imagine a future global payments network governed co-operatively by a consortium of central banks, commercial entities, and civil society groups, rather than by SWIFT (a club of banks) or big tech companies. There are challenges: commons can fail if not properly managed (the proverbial tragedy of the commons), or governance can be co-opted by the most powerful unless safeguards exist. But Ostrom showed that with the right principles, user-communities can self-regulate effectively. Already, we see **community-based currencies** in some locales – e.g. local exchange trading systems (LETS) or time banks – that allow communities to create value exchange mechanisms tailored to their values (like rewarding volunteer work with credits that can be spent locally). These are often small-scale due to lack of interoperability; however, if open digital rails can connect them to the wider economy (without subsuming them), it could foster a rich pluralism of currency systems coexisting – much as Ostrom envisioned polycentric governance solving complex social dilemmas. Ultimately, treating money and payment networks as a **commons** invites questions

of democratic governance: How do we prevent concentration of power in network governance? How to include diverse stakeholders (citizens, not just banks)? How to ensure accountability? These are political questions that must evolve alongside technology. David Shapiro's Pyramid of Power is precisely about re-balancing power – open value rails could form an **"immutable civic bedrock"** of the economy that is broadly governed and forkable (so that if abuse happens, communities could opt out and start their own). The hope is a future where financial infrastructure is *neither* Wall Street's oligopoly *nor* Big Brother's panopticon, but a **common platform** enabling innovation, equality, and liberty.

Conclusion

The emergence of open, programmable value rails represents a paradigm shift in how value can be created, distributed, and controlled in society. Technologically, it is the convergence of instant payment systems, digital currencies, and smart contracts into a new financial "stack" – one that is more open-access and software-defined. But this is not just a tech upgrade; it is a **power reconfiguration**. By design, these new rails can decentralize economic power: lowering barriers to entry, diluting incumbents' advantages, and giving individuals and communities more direct control over money. We have seen glimpses of this potential in the real world – millions newly included in India and Brazil; cross-border frictions dissolving via Singapore-India's link; grassroots funding models blooming on Ethereum; corporations pressured to adapt as public alternatives flourish. We have also seen that technology is double-edged: the same tools can be used to *liberate* or to *control*. The societal impacts – greater inclusion, new redistribution mechanisms, post-labor agency – will only fully materialize if accompanied by enlightened governance and public oversight. Similarly, the political implications – be it preserving sovereignty or preventing surveillance abuse – will depend on choices we make now in designing policies and legal frameworks for programmable money.

In summary, **Open, Programmable Value Rails** hold immense promise as the foundation for a more inclusive and innovative economic order. They can form the infrastructure for universal basic income, frictionless global commerce, and community-driven development. They can encode fairness and transparency into the fabric of financial transactions. Yet they also require us to confront hard questions about security, privacy, and governance. David Shapiro's vision situates this as a pivotal layer in empowering people in a post-labor world – a layer that connects the technological capability of abundance with the social need for equitable distribution. As we build out these rails, stakeholders from technologists and central bankers to lawmakers and citizens must collaborate to ensure the rails remain **open (accessible and interoperable), programmable (flexible to meet public needs), and fundamentally empowering**. Done right, the second layer of the Pyramid of Power could help shift us from an economy of exclusion and exploitation to one of **participation, agency, and shared prosperity**, truly making financial infrastructure a public commons for the 21st century.

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