KSCCN SERIES · DEVELOPMENT, INNOVATION AND DIGITAL ECONOMY

Structural Transformation in the Global South

Innovation and Enterprise as the New Engines of Development (Volume II)

Dr Syed Muntasir Mamun
ORCID: 0000-0001-6845-2853

Article | 11 November 2026

Companion to Mamun (2026b), *The Exhaustion of the Classical Development Toolkit*

ABSTRACT

The assumptions that guided international development for seventy years no longer hold. Official development assistance fell by 23.1% in real terms in 2025, the largest drop on record, while low- and middle-income countries paid US$436 billion more in debt service than they received in new financing between 2022 and 2025. At the same time, automation is weakening the labor-intensive export ladder: a process-level model of garment factories shows that up to 58.4% of jobs could be displaced. This second volume argues that the new engines of structural transformation are indigenous innovation, digital public infrastructure (DPI), sovereign computing capacity and domestically anchored enterprise finance. It examines India's Unified Payments Interface and Open Network for Digital Commerce, and Brazil's Pix, which processed 79.6 billion transactions in 2025. It then reviews sovereign AI strategies across four archetypes, the 2025 recalibration of venture capital in Africa, Latin America, the Middle East and Southeast Asia, and the embedded-finance model of pay-as-you-go asset lending. Every statistic was checked against primary sources for this edition. The paper concludes with four policy priorities for governments, institutions and investors in the Global South.

Keywords: structural transformation; digital public infrastructure; sovereign AI; venture capital; official development assistance; automation; embedded finance; Global South

SCOPE AND LIMITS

This volume is a companion to Mamun (2026b). Institutional statistics were checked against primary or official sources on 10 November 2026; several, including the 2025 aid data and some 2025 venture-capital totals, are preliminary or come from private data providers whose methods differ. The garment-sector figures are outputs of the author's simulation model, not observed job losses. Equation (1) is a stylized framing identity, not an econometric estimate. Maps show the latest available year for each country, and Figure 8 is categorical. A dagger (†) marks a claim that could not be independently verified for this edition.

1 Introduction

The global economic architecture of the late 2020s has fundamentally decoupled from the assumptions that guided international development for the past seventy years. A confluence of macroeconomic tightening, geopolitical fragmentation, and rapid technological advancement—specifically in artificial intelligence (AI) and digital public infrastructure (DPI)—has rendered the classical mechanisms of structural transformation largely obsolete. For emerging markets and developing economies, the pathway to high-income status can no longer rely on external aid transfers, the passive absorption of surplus labor into low-wage manufacturing, or uniform institutional transplantation. Instead, a new paradigm has emerged in which indigenous innovation, sovereign technological capabilities, and highly integrated startup ecosystems form the principal pathway into the future (Mamun, 2026b).

This second volume analyzes that macroeconomic and technological transition. By examining the structural exhaustion of the classical development toolkit, the rise of digital public infrastructure, the strategic imperative of sovereign AI, and the evolving landscape of venture capital, the analysis demonstrates that domestic enterprise and technological sovereignty are not merely second-generation reforms—they are the foundational prerequisites for economic survival and resilience in the twenty-first century. Figure 1 summarizes the argument.

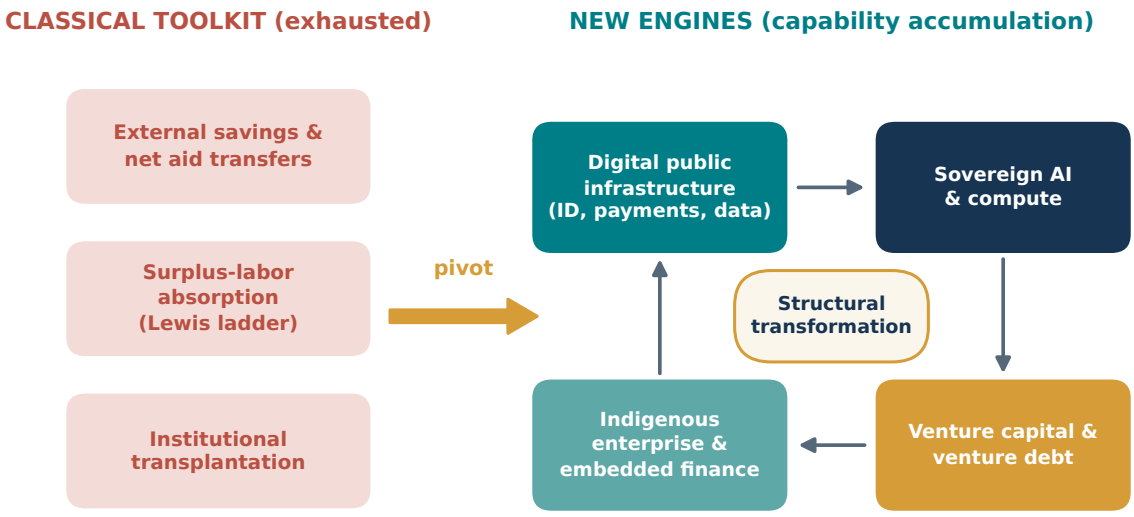


Figure 1. From the classical toolkit to the new engines of development. Author's schematic (2026); not a data figure.

2 The Exhaustion of the Classical Development Toolkit

Classical development economics, built on the theoretical foundations of the mid-20th century, prescribed a predictable sequence for structural transformation. Rosenstein-Rodan (1943) advocated a "big push" financed by external savings; Lewis (1954) modeled the absorption of surplus agrarian labor into an expanding capitalist manufacturing sector; and Chenery and Strout (1966) formalized the role of foreign assistance in closing domestic savings and foreign-exchange gaps. By 2026, empirical evidence and macroeconomic realities indicate that this toolkit has lost its principal transmission mechanisms (Mamun, 2026b).

2.1 The Collapse of the Net Aid Transfer Paradigm

The traditional financing-gap model assumed that external concessional capital could seamlessly bridge domestic savings deficits to fund industrialization. However, the architecture of official development assistance (ODA) is undergoing a structural contraction. Preliminary data from the Organisation for Economic Co-operation and Development (OECD) indicate that in 2025 ODA from members of its Development Assistance Committee fell by 23.1% in real terms to US$174.3 billion, the largest annual drop on record, returning aid to levels last seen in 2015. A further decline of 5.8% is projected for 2026 (OECD, 2026).

More critically, shrinking gross transfers are increasingly offset by mounting external debt obligations. The World Bank reports that between 2022 and 2025, low- and middle-income countries paid US$436 billion more in debt service than they received in new financing, effectively reversing the flow of capital; their external debt service reached about US$1.4 trillion in 2025 (World Bank, 2026a). Long-term net flows did turn positive again in 2025 (+US$45 billion, after −US$118 billion in 2024), but the four-year balance remains deeply negative. The structural reality of this dynamic can be expressed through a stylized fiscal-space identity representing the net developmental transfer (Mamun, 2026f; 2026b):

$$SNF_t = D_t(1 - \phi_{leak} - \tau_{tied}) - DS_t + \mu_t K_{sov,\,t-1} \tag{1}$$

where D_t represents gross disbursements, φ_{leak} denotes the share captured by intermediary overheads, τ_{tied} is the markup from tied procurement and foreign technical assistance, DS_t is external debt service, and $\mu_t\ K_{sov,t-1}$ represents the revenue multiplier on prior sovereign investments. When debt service (DS_t) approaches or exceeds gross disbursements, and when intermediation leakage remains structurally high—evidenced by local and national actors receiving a mere 0.6% (US$174 million) of humanitarian funding directly in 2023 (Development Initiatives, 2025)—the net resource transfer collapses into negative territory (Mamun, 2026d). The operational assumption that capital constraints can be solved externally is no longer valid; developing nations are forced to generate domestic capital through indigenous enterprise and technological commercialization.

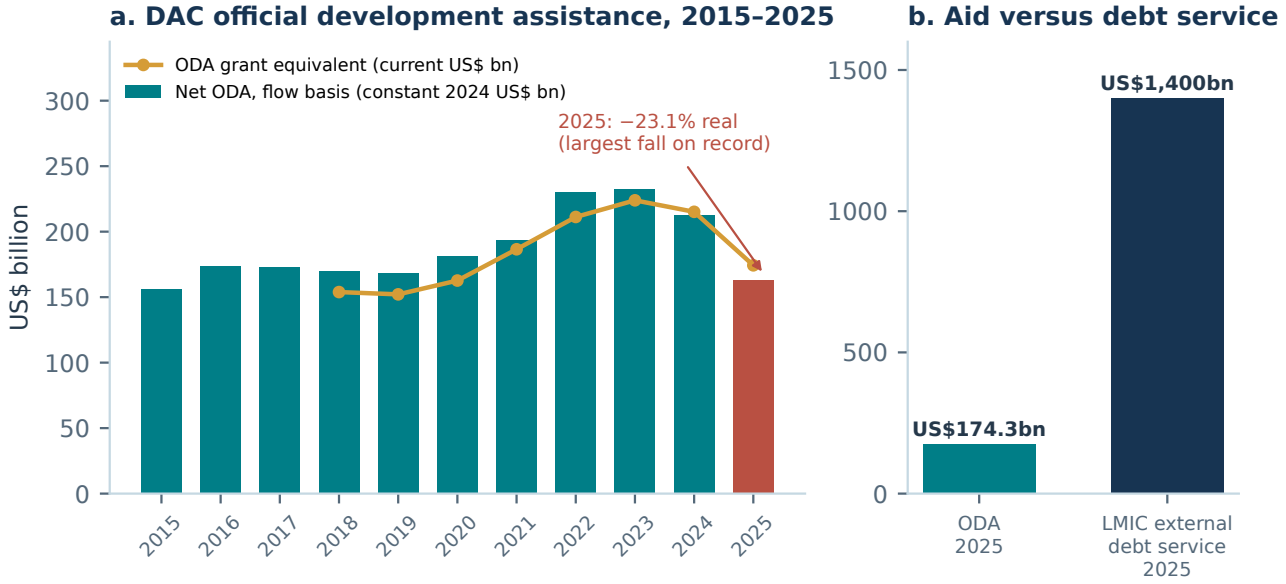


Figure 2. (a) Official development assistance from DAC members, 2015–2025: net ODA in constant 2024 US$ and ODA grant equivalent in current US$ (2025 preliminary). (b) ODA in 2025 compared with the external debt service paid by low- and middle-income countries in 2025. Sources: OECD DAC1 database (accessed 10 November 2026) and OECD (2026); World Bank (2026a).

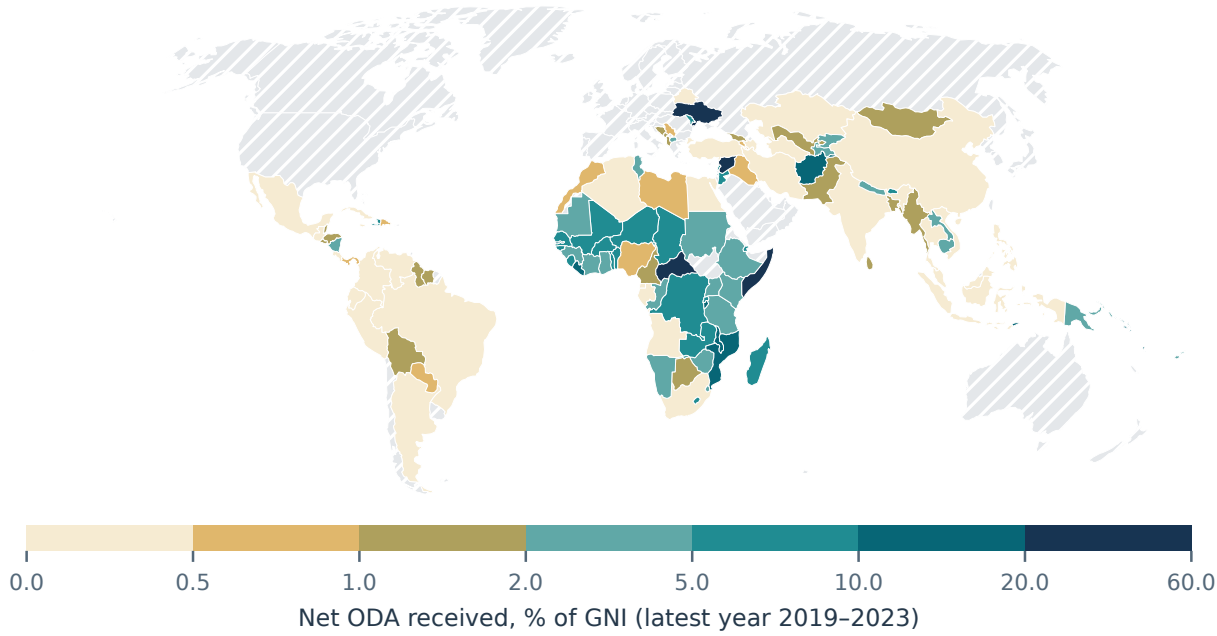


Figure 3. Net ODA received as a share of gross national income, latest available year 2019–2023. Hatched: no data or not an ODA recipient. Source: World Bank (2026b), indicator DT.ODA.ODAT.GN.ZS; boundaries: Natural Earth.

2.2 The Automation of the Labor Ladder

The Lewis model of dual-economy structural transformation relied heavily on the steady transfer of surplus labor into the modern sector. Export-led garment and electronics assembly served as the primary rung on this labor ladder. However, cognitive automation and AI are steadily dismantling this mechanism, weakening the link between export growth and mass employment generation.

Process-level simulations of ready-made garment (RMG) factories in economies heavily reliant on export manufacturing, such as Bangladesh, illustrate severe employment displacement under modern AI deployment. The model indicates that advanced automation and AI can eliminate up to 58.4% of roles in a standard 1,500-worker factory. This displacement disproportionately affects women, who account for roughly 66% to 67% of displaced workers across all modeled scenarios (Mamun, 2026e).

Table 1. Simulated employment displacement in RMG manufacturing: the automation of the traditional labor ladder

Automation scenario	Projected job losses (per 1,500 workers)	Reduction rate	Indicative sector-level loss (Bangladesh)
Partial automation (current trend)	506	33.7%	~1.35 million jobs
Advanced automation + AI	876	58.4%	~2.3 million jobs
Near-full automation (theoretical maximum)	1,126	75.1%	~3.0 million jobs

Source: Mamun (2026e), model outputs for a standard 1,500-worker factory; sector-level figures are the model's indicative extrapolations, not observed losses.

The arithmetic of the labor ladder is dictated by the growth decomposition $L_t = l_t X_t$, where L is employment, X is real export output, and l is the labor coefficient. For the classical mechanism to function, the growth rate of export output (g_X) must comfortably exceed the rate at which the labor coefficient declines (g_l) (Mamun, 2026b). Independent evidence from the Research and Policy Integration for Development (RAPID) institute shows that while Bangladesh's RMG exports more than tripled from US$12.5 billion in 2010 to US$40 billion

in 2024, sector employment stagnated at approximately four million. The number of workers required to produce US$1 million of exports fell from 220 to about 90 (RAPID, 2025).

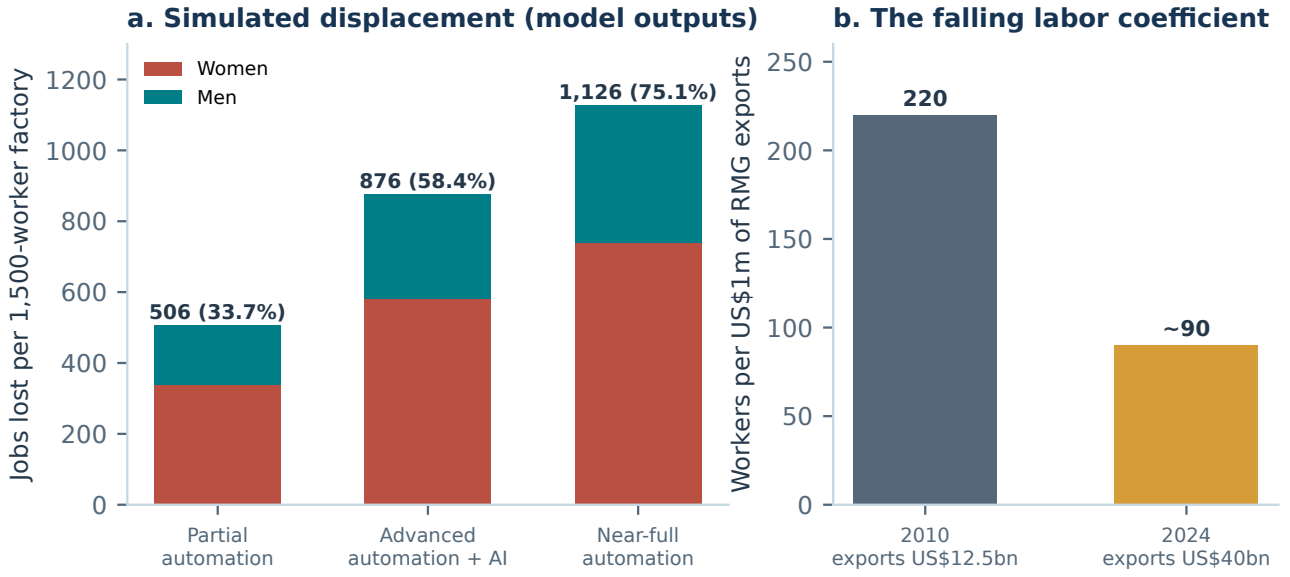


Figure 4. (a) Simulated job losses per 1,500-worker RMG factory by scenario, split by gender (model outputs). (b) Workers needed per US$1 million of RMG exports in Bangladesh, 2010 and 2024. Sources: Mamun (2026e); RAPID (2025).

As AI and advanced robotics accelerate the decline of the labor coefficient, the export sector may increase in total output and productivity, but it ceases to act as an engine for mass labor absorption. Consequently, premature deindustrialization is accelerating, forcing developing nations to leapfrog directly into digital services, technology-driven enterprise, and indigenous innovation to generate sustainable employment (Rodrik, 2016; Mamun, 2026b).

3 The New Architecture of Industrialization and Innovation

Recognizing the limits of legacy growth models, global economic institutions emphasize a transition from capacity expansion toward domestic innovation. The World Bank counts 108 middle-income countries, many at risk of the "middle-income trap" once the returns on basic infrastructure, urbanization and imported technologies are exhausted (World Bank, 2024). Breaking this ceiling requires an explicit shift toward Industry 5.0, a paradigm in which physical production integrates with digital systems, AI, automation, and sustainable resource management (Eurasian Development Bank, 2026).

3.1 The Investment–Innovation Disconnect

Capital accumulation without domestic technological capability yields diminishing returns. A highly illustrative case is Kazakhstan's metallurgical industry. While the sector underwent an investment-led structural expansion consistent with Sustainable Development Goal (SDG) 9 (industry, innovation, and infrastructure), domestic innovation inputs—such as R&D intensity—and outputs—such as patenting activity—remained disconnected from production growth; the estimated elasticity of output with respect to investment was 0.53 (Tazhibayev, 2026). The resulting divergence left the country with an "unfinished transformation." The economy achieved headline output growth driven by fixed capital formation but failed to secure the sustainable productivity gains that arise from indigenous innovation; national gross expenditure on R&D was just 0.16% of GDP in 2024, against a world average of 2.60% (World Bank, 2026b).

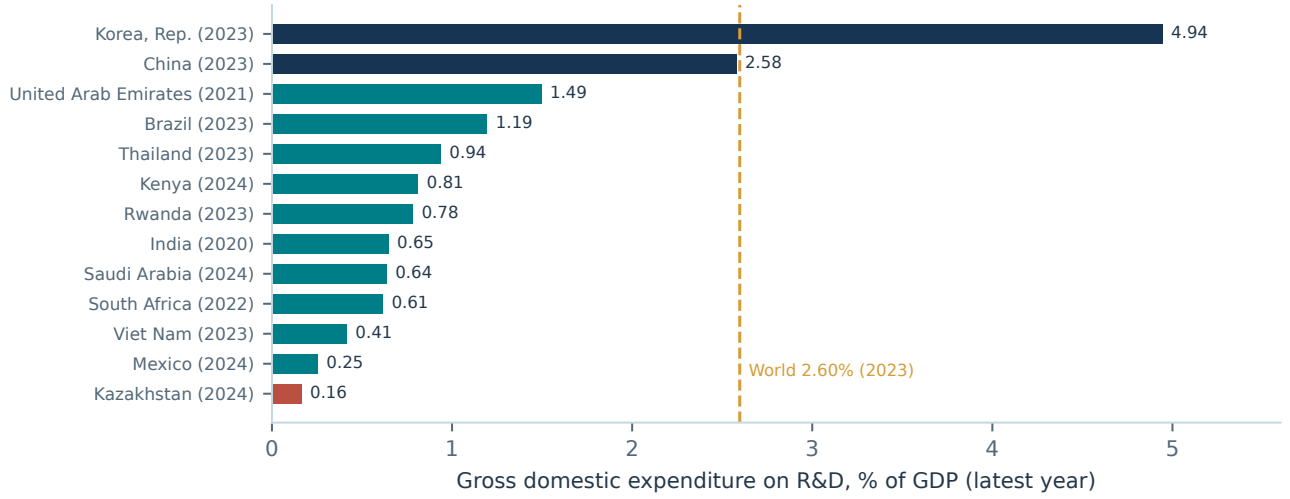


Figure 5. Gross domestic expenditure on R&D, % of GDP, latest available year, for economies discussed in the text, with the world average for 2023. Source: World Bank (2026b), indicator GB.XPD.RSDV.GD.ZS (UNESCO Institute for Statistics).

Cross-country analyses corroborate this dynamic. The transition from accessing imported technology to adapting it, and ultimately to creating domestic innovation, is the defining threshold for emerging economies. The optimal sequence begins with a foundational industrial base that builds basic skills, progresses to technology absorption, and culminates in applied R&D, intellectual property creation, and commercialization (Eurasian Development Bank, 2026). Studies reviewed by Tazhibayev (2026) report that R&D investment and patent applications Granger-cause economic growth and raise economic complexity, though the link is weaker in peripheral economies lacking dense knowledge networks, and that digital transformation raises firm innovation mainly where adequate talent is present. Developing nations must therefore actively cultivate domestic digital talent and infrastructure.

3.2 Reconceptualizing Institutional Voids

Classical development policy viewed weak institutions in the Global South as deficits requiring the transplantation of Western regulatory templates and conditionality. A more nuanced, innovation-driven perspective treats these “institutional voids” as native design spaces. Through digital public infrastructure, smart contracts, and AI verification, developing nations can build agile, fluid institutions that bypass legacy bureaucracies. This fluid institutionalism allows startups and enterprises to scale without the frictional costs that historically suppressed enterprise in the developing world (Mamun, 2026c; 2026b).

4 Digital Public Infrastructure as the Substrate of Enterprise

If physical infrastructure defined the industrial era, digital public infrastructure defines the modern digital economy. DPI refers to foundational, interoperable digital building blocks—primarily digital identity, fast payment systems, and secure data-exchange layers—designed to serve the public interest and accelerate safe, inclusive digital transformation. DPI radically alters the transaction-cost economics of the Global South, formalizing informal markets, reducing leakages in government-to-person (G2P) transfers, and providing the technological substrate upon which startup ecosystems flourish (World Bank, 2025). Its reach is bounded by connectivity, which remains uneven (Figure 6).

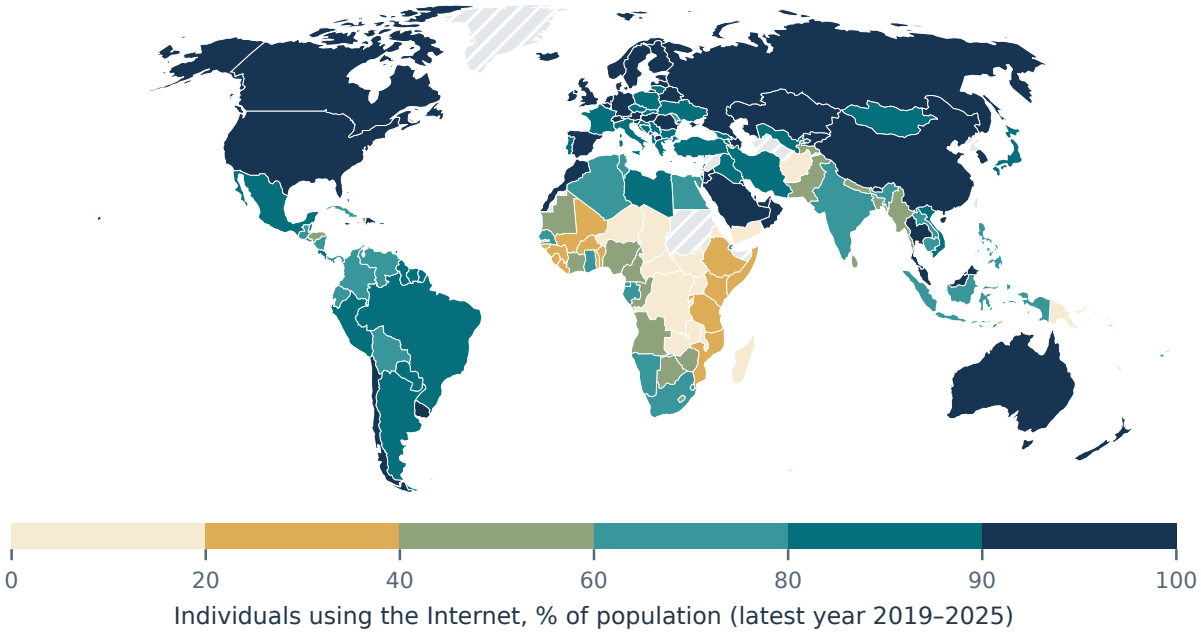


Figure 6. Individuals using the internet, % of population, latest available year (mostly 2024–2025). Source: World Bank (2026b), indicator IT.NET.USER.ZS (ITU); boundaries: Natural Earth.

4.1 The Indian DPI Model: UPI and ONDC

India's approach to DPI, colloquially known as the "India Stack," represents a paradigm shift in how states catalyze innovation. The Unified Payments Interface (UPI) functions as an open-API digital payment rail that has rewired the Indian economy. In December 2025 UPI processed a record 21.6 billion transactions in a single month; over calendar 2025 it handled about 228 billion transactions worth nearly ₹300 lakh crore (about US$3.4 trillion) (NPCI, 2026). India alone accounted for 49% of the world's real-time payment transactions in 2023 (ACI Worldwide, 2024).

The second-order economic effects are profound. In one mediation analysis, transaction-cost reduction accounts for an estimated 42.2% of UPI's financial-inclusion effect (Balasundaram et al., 2026, as reported by Khan and Khan, 2026). Because UPI carries a zero Merchant Discount Rate (MDR), it eliminates the regressive fees that historically deterred micro-merchants from accepting digital payments. This has supported the formalization of informal businesses, making them eligible for data-driven credit and accelerating the velocity of transactions. Business registrations increased by up to 27% in highly UPI-integrated rural villages in a study of 200 villages across four states, providing evidence of DPI's role in rural economic transformation (Balasundaram et al., 2026).

Building on the success of UPI, the Open Network for Digital Commerce (ONDC) aims to loosen the hold of dominant e-commerce platforms. Incorporated in December 2021 as a not-for-profit company with initial investments from the Quality Council of India and Protean eGov Technologies, ONDC operates on the decentralized, open-source Beckn protocol. ONDC unbundles the e-commerce value chain, allowing a consumer using a banking app to purchase inventory directly from a rural artisan using a localized seller app, fulfilled by an independent third-party logistics provider—all communicating via standardized APIs.

Table 2. Core components of the Beckn protocol underlying India's ONDC

Protocol feature	Mechanism and impact on the enterprise ecosystem
Decentralization	Uses decentralized technologies to enable peer-to-peer interactions, reducing intermediaries and costs and widening visibility for MSMEs.
API standardization	Provides standard interfaces allowing diverse buyer apps, seller apps, and logistics providers to interoperate without compatibility barriers.
Unified digital identity	Lets users maintain a single, consistent identity across multiple services within the network, bypassing siloed platform logins.
Governance framework	Employs reputation systems and cryptographic techniques to establish trust, dispute resolution, and accountability among stakeholders.
Scalability	Low-friction onboarding architecture designed for large transaction volumes, supporting rapid enterprise scaling without centralized bottlenecks.

Source: author's summary of ONDC and Beckn protocol documentation (descriptive; no statistics).

By August 2025, ONDC facilitated about 17.9 million transactions a month, although most were mobility rides (11.8 million) and logistics orders (2.4 million); retail orders had fallen to 3.8 million from 6.1 million a year earlier (Moneycontrol, 2025). The network continues to court India's large base of offline kirana stores, estimated at more than 13 million.† It has also expanded to Public Distribution System fair price shops: a February 2024 pilot onboarded 11 such shops in the Una and Hamirpur districts of Himachal Pradesh, giving dealers an additional income channel (PIB, 2024). This infrastructure treats digital commerce as an inclusive public utility rather than a private rent-seeking enterprise, enabling indigenous startups to compete on product quality rather than customer-acquisition budgets—although the decline in retail volumes shows that open protocols do not by themselves guarantee adoption.

† Not independently verified for this edition: the figure of about 13 million kirana stores is a widely quoted industry estimate; no official census was located.

4.2 Brazil's Pix: Universal Financial Inclusion and Market Evolution

Similarly, Brazil's Central Bank launched Pix in November 2020, an instant payment rail in which participation is mandatory for large institutions, and which has achieved unprecedented scale and redefined merchant economics in Latin America. In 2025 about 86% of Brazilians over the age of 14 used Pix, and the system set a record of 313.3 million transactions in a single day on 5 December 2025 (Banco Central do Brasil, 2026b). Cumulatively, from its launch to the end of 2025, Pix processed about 218 billion transactions worth roughly R$95 trillion (about US$17.7 trillion), around seven and a half times Brazil's 2025 GDP. In 2024 alone, Pix handled 63.4 billion transactions, about 74% more than credit and debit card transactions combined (36.4 billion), and in 2025 it reached 79.6 billion (Banco Central do Brasil, 2026a).

Table 3. The growth of Brazil's Pix payment system, 2021–2025

Year	Annual transactions	Transaction value (BRL)	Transaction value (USD)
2021	9.4 billion	R$5.2 trillion	US$0.96 trillion
2022	24.0 billion	R$10.9 trillion	US$2.1 trillion
2023	41.7 billion	R$17.1 trillion	US$3.4 trillion
2024	63.4 billion	R$26.4 trillion	US$4.9 trillion
2025	79.6 billion	R$35.3 trillion	US$6.3 trillion

Source: Banco Central do Brasil (2026a), payment statistics open data (quarterly series summed by year), accessed 10 November 2026. USD values converted at the World Bank annual average exchange rate (R$5.39, 5.16, 5.00, 5.39 and 5.59 per US$).

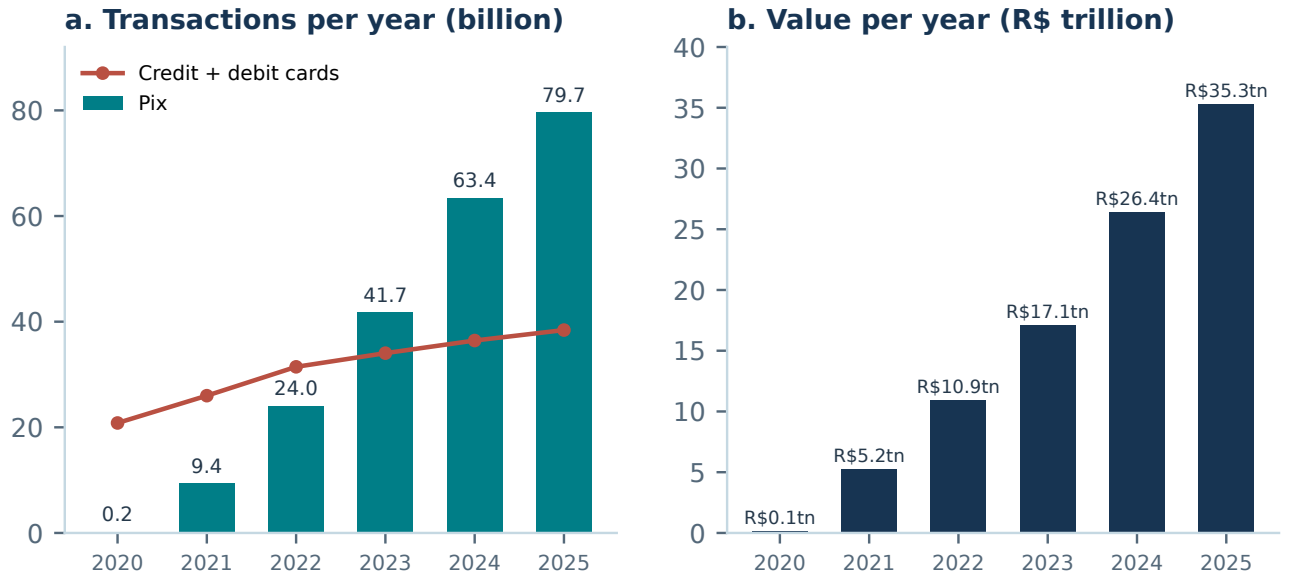


Figure 7. Brazil's Pix compared with credit and debit cards: annual transactions (billions) and Pix transaction value (R$ trillion), 2020–2025. Source: Banco Central do Brasil (2026a), payment statistics open data, accessed 10 November 2026.

Pix succeeded because of deliberate regulatory design. By mandating participation for large financial institutions, the Central Bank guaranteed immediate network effects and interoperability (Khan and Khan, 2026). For merchants, Pix cost on average about 0.33% of the transaction value, against 2.34% for credit cards and 1.13% for debit cards in the fourth quarter of 2022 (Banco Central do Brasil, 2023). This cost asymmetry propelled person-to-business (P2B) payments to 43% of Pix transactions in 2025 (Banco Central do Brasil, 2026b), as formalization expanded into the gig economy and informal sectors—evidence that well-governed DPI can act as a direct stimulus for domestic enterprise.

The system's evolution continues to open new enterprise pathways. The introduction of Pix Agendado (scheduled transfers), Pix por aproximação (contactless NFC payments), and Pix Automático (recurring payments, launched on 16 June 2025) democratizes subscription billing for small businesses previously reliant on expensive card infrastructure or cumbersome boleto slips. By replacing legacy infrastructure with agile, low-friction rails, Pix has established a replicable blueprint for the Global South; market-led arrangements already let Brazilians pay with Pix abroad in countries including Chile, Argentina, the United States, Portugal and France (Banco Central do Brasil, 2026b).

Crucially, the parallel successes of Pix and UPI highlight that digital financial inclusion requires robust governance. Without a cohesive DPI architecture characterized by open APIs, regulatory consumer protection, and state capacity, high internet penetration alone fails to drive digital economic integration or trust (Khan and Khan, 2026).

5 The Geopolitics and Enterprise of Sovereign AI

In the classical development model, financial capital and foreign exchange were the primary binding constraints. In the era of Industry 5.0, the frontier constraint has shifted toward "compute"—the physical hardware and software infrastructure critical for scaling AI systems. AI infrastructure—specifically high-performance GPU clusters, high-bandwidth memory, and the power required to run them—is increasingly rationed globally owing to capital intensity, supply constraints, export controls, and geopolitical maneuvering (Mamun, 2026a; 2026b).

5.1 Escaping the Compute Desert

For the developing world, the failure to secure domestic AI infrastructure results in relegation to "compute deserts"—regions dependent on foreign-hosted, multinational cloud systems, serving merely as passive consumers of imported technology (Mamun, 2026a). This dependency carries risks regarding data privacy, algorithmic bias, cultural and linguistic erasure, and economic lock-in. As a result, by mid-2025 nearly 70 countries had adopted national AI strategies and policies (OECD.AI, 2025), many treating AI compute capacity as a strategic national asset comparable to physical critical infrastructure.

Data-protection and data-localization rules—including the EU's General Data Protection Regulation, with its limits on cross-border transfers, India's Digital Personal Data Protection Act 2023, and China's Data Security Law—create compliance-driven requirements for domestic processing that some AI deployments on foreign-owned infrastructure struggle to satisfy. Consequently, governments are mobilizing capital at an unprecedented scale, transforming states into industrial-policy actors, innovation catalysts, and direct owners of strategic technological assets (OECD, 2025).

5.2 Archetypes of Sovereign AI Development

The pursuit of sovereign AI requires navigating high capital expenditure and acute energy constraints. Several distinct structural archetypes of sovereign deployment have emerged (Figure 8):

- **Capital-abundant, compute-intensive (Middle East):** Nations such as the UAE and Saudi Arabia are leveraging sovereign wealth to build capacity. Saudi Arabia's Public Investment Fund has allocated more than US$40 billion to AI investments (Signé, 2026); in the UAE, Microsoft invested US$1.5 billion in G42 in 2024, and the Technology Innovation Institute developed the open Falcon models. These moves show how sovereign capital can force entry into the frontier tier of AI infrastructure, prioritizing national control over the full AI lifecycle.
- **Scale and DPI-integrated (India):** India approaches sovereign AI as an extension of its digital public goods. The IndiaAI Mission, approved in March 2024 with an outlay of ₹10,371.92 crore (about US$1.25 billion), had made more than 38,000 GPUs available by October 2025, well above its initial target of 10,000, at an average subsidized rate of about ₹65 per GPU-hour (PIB, 2025). In February 2026, G42 and Cerebras announced an 8-exaflop supercomputer for India with C-DAC and MBZUAI. Rather than treating compute solely as a strategic asset, India is structuring it as a public good offered to startups below market cost, fostering an indigenous AI ecosystem exemplified by Sarvam AI, selected in April 2025 to build a sovereign foundation model.
- **Renewable power arbitrage (Latin America):** Countries with abundant renewable energy, such as Brazil, where 88% of electricity comes from renewable sources (Signé, 2026), and Paraguay, with its large hydropower surplus, are positioning themselves as sustainable compute hubs. Conversely, Mexico faces acute grid constraints in industrial corridors such as Querétaro, highlighting power as the ultimate gating factor for AI deployment.
- **Ecosystem partnerships (Africa and Southeast Asia):** Regions constrained by both public capital and grid stability are adopting public–private partnership models. Telecom operators (for example, Viettel in Viet Nam and True IDC in Thailand) are partnering with global technology firms to establish localized, sovereign-compliant data centres. Africa is home to about 18% of the world's population but less than 1% of global data-centre capacity (World Economic Forum, 2025); overcoming this deficit through partnerships is critical for training contextually relevant models.

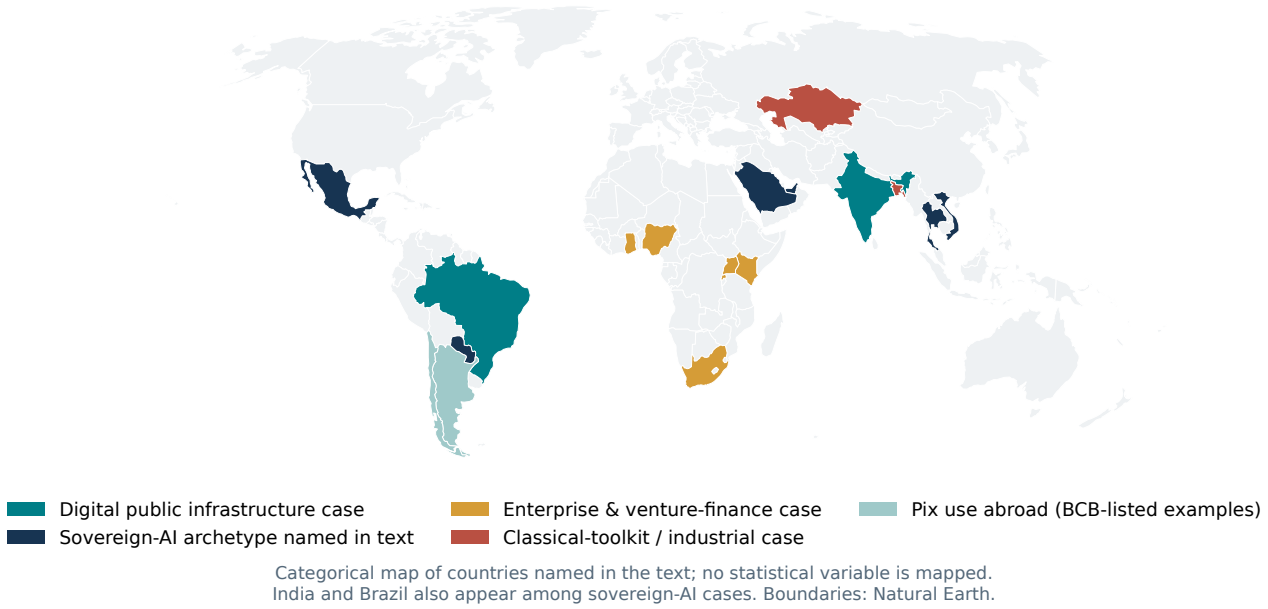


Figure 8. Countries named in the text, by the role they play in the argument. Categorical map: no statistical variable is mapped. Sources: this article; BCB-listed examples of Pix use abroad from Banco Central do Brasil (2026b); boundaries: Natural Earth.

Sovereign AI helps the Global South capture the economic value of AI deployment—estimated at up to US$1.2 trillion for Africa's economy by 2030, about 6% of GDP (Signé, 2026)—rather than merely exporting raw data and importing expensive, externally trained models. European initiatives such as the EuroHPC Joint Undertaking's AI Factories show how pooling regional compute can give domestic startups access to infrastructure that would otherwise be prohibitively costly, providing a blueprint for regional cooperation in the Global South (OECD, 2025; Mamun, 2026f).

6 Financing the Enterprise Pathway: Venture Capital in the Global South

As official development assistance recedes and state capacity pivots toward foundational infrastructure such as DPI and sovereign compute, the financing of enterprise commercialization has migrated increasingly to private venture capital (VC). Startup ecosystems are recognized as engines of economic diversification and job creation; the World Bank estimated that some 600 million new jobs would be needed worldwide over fifteen years (World Bank, 2012), a target unachievable without vibrant, well-capitalized entrepreneurial sectors.

6.1 The Recalibration of Global South Venture Capital

The venture capital landscape experienced a significant recalibration between 2024 and 2026. The United States remains the dominant gravitational center, capturing US$274 billion, or 64%, of the US$425 billion invested globally in 2025 (Crunchbase News, 2026a). Ecosystems in the Global South are maturing and diversifying, albeit navigating distinct regional headwinds (Table 4; Figure 9).

Table 4. Venture capital flows and ecosystem characteristics in emerging markets, 2025

Region	2025 VC funding	YoY growth	Ecosystem characteristics
Middle East/MENA	US$7.5 billion	+225%	Includes about US$4 billion of debt financing; Saudi Arabia (about US$5 billion) and the UAE (about US$2 billion) led, with large sovereign-linked and AI-infrastructure deals.
Southeast Asia	US$5.2 billion	+7%	Concentrated in late-stage rounds; Singapore-based firms took 91% of funding. Seed funding fell 57%, signalling early-stage capital scarcity.
Latin America	US$4.1 billion	+14%	Post-slump recovery anchored by fintech and consumer-class expansion in Brazil (US$2.1 billion) and Mexico (US$1.1 billion).
Africa	US$4.1 billion	+25%	Recovery marked by alternative capital: venture debt reached a record US$1.64 billion (41% of the total); equity rose 8% to US$2.41 billion.

Sources: Wamda (2026) for MENA; Tracxn (2026) for Southeast Asia (tech funding); Crunchbase News (2026b) for Latin America; Partech (2026) for Africa (whole continent, equity plus debt). Providers' definitions differ, so totals are not strictly comparable.

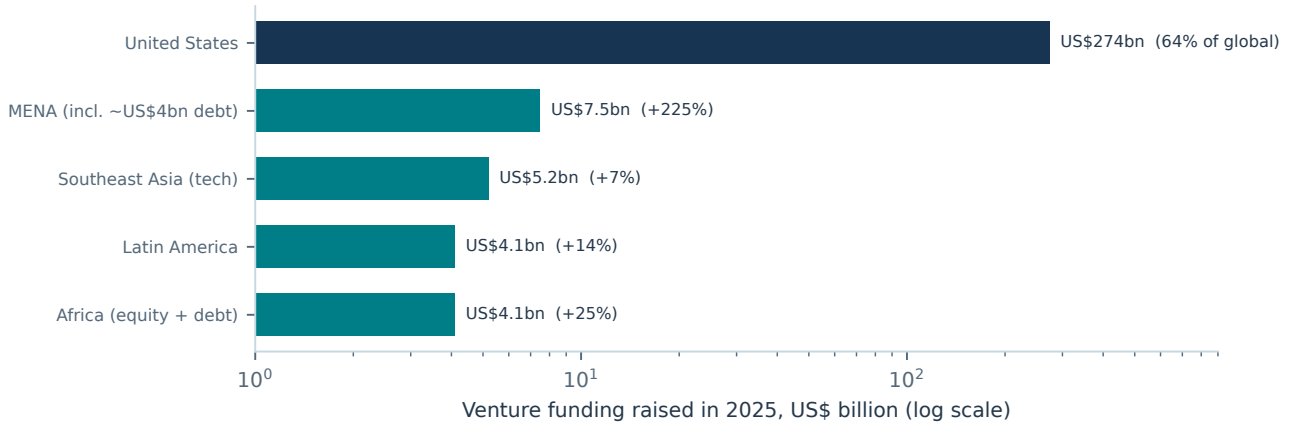


Figure 9. Venture funding in 2025 by region (log scale), with the United States and the global total for reference. Sources: Crunchbase News (2026a; 2026b); Wamda (2026); Tracxn (2026); Partech (2026). Provider definitions differ.

In Africa, equity VC contracted sharply in 2024: VC deal value fell 28% to US$2.6 billion and deal volume fell 21% to 427 deals, while the number of active investors stood at 614 (AVCA, 2025). The pullback of foreign capital nonetheless catalyzed a more domestically anchored recalibration. In 2025 total funding rebounded by 25% to US$4.1 billion, and average Series A and Series B round sizes rose by 21% and 12% respectively (Partech, 2026). Combined with AVCA's finding that a third of 2024 capital recipients were raising their first round, this indicates that local founders continue to incubate indigenous solutions tailored to market realities.

Furthermore, venture debt has emerged as a mainstream financing vehicle. In 2025, venture debt in African tech reached a record US$1.64 billion (41% of all capital invested), up 63% year on year (Partech, 2026). This debt capital suits mature cleantech, energy, and asset-financing startups that need working capital to scale physical infrastructure without punitive equity dilution.

The global market is also experiencing a persistent "Series A crunch," where seed-funded companies struggle to secure follow-on growth capital as investors demand proven product–market fit, capital efficiency, and robust unit economics over growth at all costs. Secondary markets are expanding rapidly—global secondary volume reached a record of about US$226 billion in 2025 (Evercore, 2026)—although this volume is dominated by private-equity funds; a smaller but growing venture segment provides liquidity to founders and early employees and reduces the pressure to relocate or sell prematurely. In Africa, venture-backed exits are gaining momentum, with 138 exits recorded between 2019 and 2024, 111 of which (80%) were trade sales (AVCA, 2025).

6.2 Specialized Funds and Sectoral Diversification

The maturity of emerging startup ecosystems is reflected in the rise of specialized, localized investment funds and an expansion beyond traditional e-commerce. Fintech continues to lead—raising US$769 million in Africa in 2025, 25% of total equity funding—supported by DPI implementations that reduce customer-acquisition costs. Capital is diversifying, however: cleantech equity funding rose 186% to US$550 million in 2025 (Partech, 2026).

Local and Africa-focused investors are increasingly leading rounds, with African investors forming the single largest group (31%) of active VC participants on the continent in 2024 (AVCA, 2025). Specialized vehicles are emerging to fund deep tech: Enza Capital, for instance, launched a dedicated fund for African AI startups building locally optimized, commercially viable tools that overcome regional infrastructural limitations and digitize legacy industries (TechCabal, 2026). Similarly, the government-backed Rwanda Innovation Fund, supported by a US$30 million African Development Bank loan, provides structured support to early-stage tech ventures, and the South-South Collective for the Climate (S2C2) aims to support more than 5,000 climate-tech startups across the Global South by 2030 to advance adaptation and decarbonization goals (UNFCCC, 2025).

Interestingly, some multi-region startups appear to be shifting their playbooks: rather than pursuing pan-African expansion alone, mature startups are using later-stage funding to scale into complementary emerging markets in Southeast Asia and Latin America, transferring indigenous knowledge across the Global South.†

† Not independently verified for this edition: the claim of horizontal expansion into Southeast Asia and Latin America is attributed in the source to AVCA (2025), but no supporting passage was found in that report.

7 Embedded Finance and the Formalization of the Informal Economy

The theoretical convergence of digital public infrastructure, startup enterprise, and structural transformation is best exemplified by the rise of embedded finance and asset-backed micro-credit in regions lacking legacy banking infrastructure (Figure 10).

7.1 The M-KOPA Case Study: Engineering Financial Inclusion

In Sub-Saharan Africa, traditional banking models alone cannot drive economic transformation. According to the Global Findex 2025, 58% of adults in the region had a financial account in 2024, which leaves 42%—some 300 million adults—outside formal finance, and only 14% of low-income adults borrowed from a financial institution or through a mobile money account (CGAP, 2026). Startups have bridged this institutional void through technological innovation.

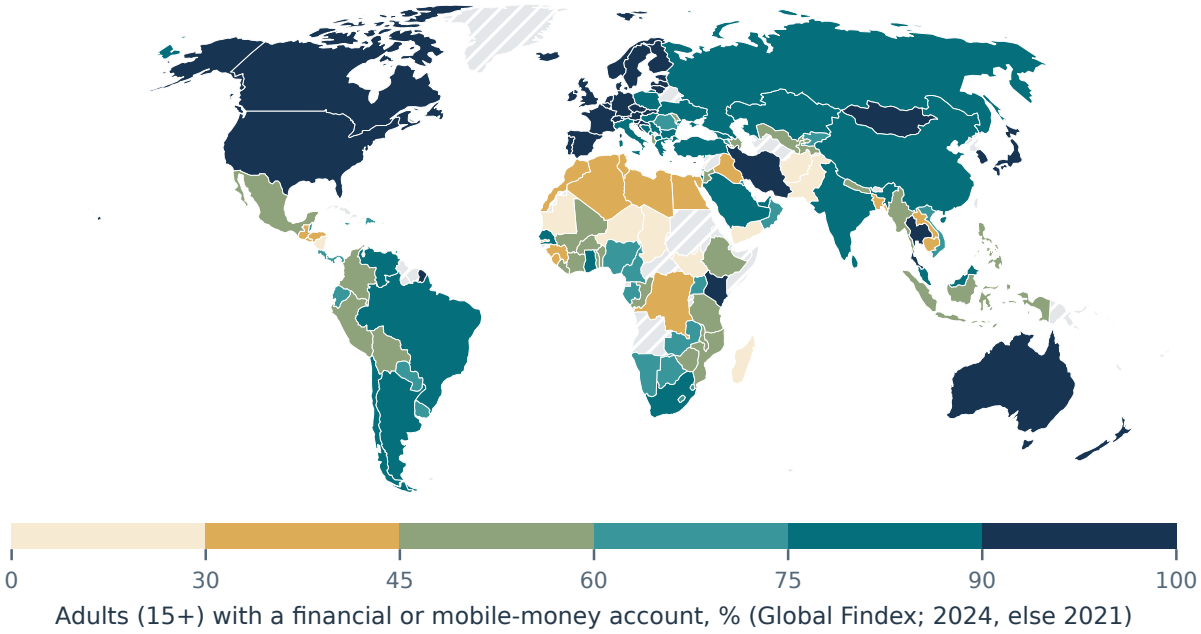


Figure 10. Adults (15+) with an account at a financial institution or a mobile-money provider, %, Global Findex 2024 (2021 where 2024 is unavailable). Source: World Bank (2026b), indicator FX.OWN.TOTL.ZS (Global Findex Database 2025); boundaries: Natural Earth.

M-KOPA, a fintech pioneer operating in Kenya, Uganda, Nigeria, Ghana and South Africa, provides pay-as-you-go (PAYG) financing for productive assets, primarily smartphones, solar home systems and e-motorbikes. By 2025, M-KOPA had served more than 7 million customers and disbursed over US$2 billion in credit. Its customers represent the core of the informal economy: "Every Day Earners," half of whom live on less than US$5.50 a day, with 62% under the age of 35 (M-KOPA, 2025).

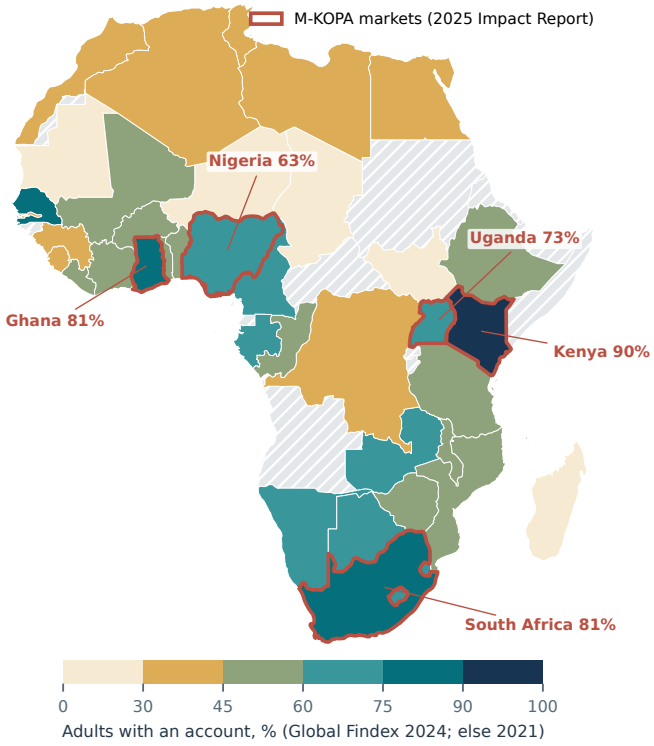


Figure 11. Account ownership in Africa, Global Findex 2024 (2021 where 2024 is unavailable), with the five M-KOPA markets outlined. Sources: World Bank (2026b), indicator FX.OWN.TOTL.ZS; M-KOPA (2025); boundaries: Natural Earth.

The operating mechanism of this enterprise shows how institutional voids can be overcome and risk mitigated without traditional collateral. The financed asset—such as a smartphone—carries software that allows the device to be remotely locked if micro-repayments, often made daily according to variable cash flows, are missed. This flexible repayment model matches the volatile cash-flow patterns of informal workers without late fees or penalties, and customers can return the product at any time for a full deposit refund (M-KOPA, 2025).

More importantly, these continuous daily digital payments generate a rich behavioral data trail. Processing more than 1.5 million payments a day with AI-driven analytics, M-KOPA builds credit histories for populations otherwise "invisible" to conventional finance. Once an initial asset is paid off, the user can access further products, including loans for health, business expansion or education, alongside device protection and insurance (M-KOPA, 2025).

This model suggests that asset-backed micro-credit, distributed by private enterprise, can be a more effective mechanism than traditional bank lending for bringing the informal economy into the digital era. Alongside peers such as Sun King and Zola Electric, these enterprises operate at scale in the PAYG off-grid solar and digital-asset markets. By providing the hardware (smartphones), the connectivity (digital ecosystem access), and the capital (micro-loans), private enterprise is executing a developmental mandate that state institutions and classical aid paradigms historically struggled to achieve.

8 Strategic Outlook and Conclusions

The global development paradigm has fundamentally shifted. The classical toolkit—premised on external aid transfers, the expectation of uniform institutional transplants, and the passive absorption of cheap labor into export manufacturing—is structurally exhausted (Mamun, 2026b). In its place, development policy must explicitly pivot toward capability accumulation, prioritizing the rapid expansion of digital public infrastructure, the acquisition of sovereign computing power, and the cultivation of indigenous startup ecosystems (Mamun, 2026f). Figure 12 traces the milestones discussed in this volume.

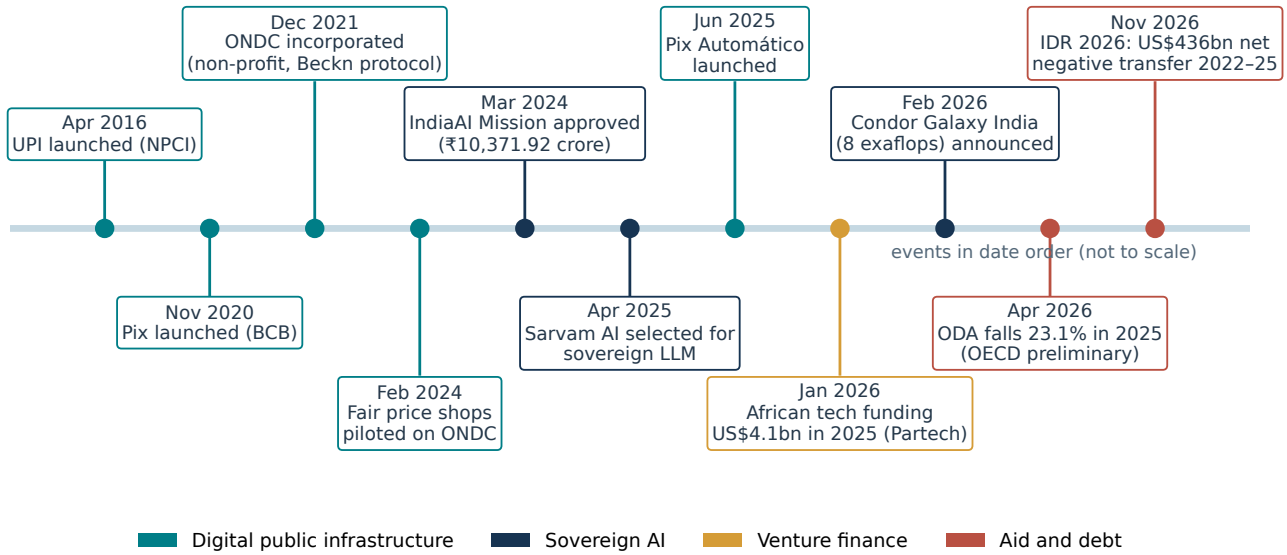


Figure 12. Milestones discussed in this volume, 2016–2026, in date order (not to scale). Sources: as cited in the text.

Analysis of current macroeconomic and technological trends yields several actionable insights for policymakers, global institutions, and investors in the Global South:

- **DPI as a macroeconomic prerequisite:** Digital public infrastructure is no longer a peripheral digitization initiative; it is the baseline for modern commerce. Governments should prioritize zero- or low-fee payment rails (akin to Brazil's Pix and India's UPI) and open, interoperable commercial protocols (such as ONDC) to collapse transaction costs, contest digital monopolies, and integrate micro, small and medium enterprises into the national economy.
- **Sovereign AI as critical national infrastructure:** Reliance on foreign cognitive infrastructure is a strategic vulnerability. Developing nations should allocate capital to secure domestic GPU compute capacity, using public–private partnerships where state capital is insufficient. Policymakers should treat data centres, data residency, and AI talent with the same strategic priority historically reserved for national power grids and transportation networks (Mamun, 2026a).
- **Venture capital as the new development finance:** Given the structural contraction in official development assistance and the rising burden of external debt service, states should actively incentivize local venture capital and venture-debt markets. Regulatory clarity, startup acts, fluid institutional frameworks, and state-backed funds of funds are essential to de-risk investment in high-impact sectors such as climate tech, digital logistics, and applied AI (Mamun, 2026d; 2026f).
- **Institutional voids as native design spaces:** Rather than waiting for Western-style legacy institutions to mature, emerging markets should leverage decentralized networks, AI verification, and mobile-first enterprise solutions to leapfrog structural deficits. The success of PAYG asset-financing models demonstrates that technology can create trust and creditworthiness where traditional institutions are absent (Mamun, 2026c).

Innovation and enterprise are no longer optional or peripheral components of an economic growth strategy; they are the core engines of structural transformation. The nations that successfully navigate the middle-income trap in the twenty-first century will be those that cease to be passive consumers of global technology and imported capital, and instead become the sovereign architects of their own digital, industrial, and entrepreneurial futures.

References

ACI Worldwide (2024) *Prime Time for Real-Time 2024*. Miami, FL: ACI Worldwide.

African Private Capital Association (AVCA) (2025) *2024 Venture Capital in Africa Report*. London: AVCA. Available at: https://www.avca.africa/data-intelligence/research-publications/2024-venture-capital-in-africa-report/.

Balasundaram, E., Anandavel, V., Navalgund, N., Aranganathan, P. and Hanji, S. (2026) 'The impact of digital public infrastructure on financial inclusion and economic growth in rural India: evidence from the UPI revolution', Indian Growth and Development Review, 19(1), pp. 109–126. doi:10.1108/IGDR-12-2024-0213.

Banco Central do Brasil (2023) *Relatório de Gestão do Pix 2023*. Brasília: BCB.

Banco Central do Brasil (2026a) *Estatísticas de meios de pagamento: dados abertos (MPV_DadosAbertos)*. Brasília: BCB. Available at: https://olinda.bcb.gov.br/olinda/servico/MPV_DadosAbertos/versao/v1/aplicacao.

Banco Central do Brasil (2026b) *Relatório de Gestão do Pix 2026*. Brasília: BCB.

CGAP (2026) 'Africa's next financial inclusion challenge lies beyond access', CGAP Blog, 5 November. Available at: https://www.cgap.org/blog/africas-next-financial-inclusion-challenge-lies-beyond-access.

Chenery, H.B. and Strout, A.M. (1966) 'Foreign assistance and economic development', American Economic Review, 56(4), pp. 679–733.

Crunchbase News (2026a) ‘Global venture funding in 2025 surged as startup deals and valuations set all-time records’. Available at: https://news.crunchbase.com/venture/funding-data-third-largest-year-2025/.

Crunchbase News (2026b) ‘LatAm startup funding rebounds in 2025 as Mexico sees surge in investment and VCs remain bullish on region’. Available at: https://news.crunchbase.com/venture/vcs-bullish-latam-startup-funding-rebounds-2025/.

Development Initiatives (2025) *Falling Short? Humanitarian Funding and Reform – Funding to Local and National Actors*. Bristol: Development Initiatives. Available at: https://devinit.org/resources/falling-short-humanitarian-funding-reform/funding-local-national-actors/.

Eurasian Development Bank (2026) *The Architecture of Industrial Transformation in Developing Economies*. Almaty: EDB.

Evercore (2026) *2025 Secondary Market Report*. New York: Evercore Private Capital Advisory. Available at: https://www.evercore.com/wp-content/uploads/2026/02/Evercore-PCA-2025-Secondary-Market-Report.pdf.

Khan, M. and Khan, S. (2026) ‘Digital public infrastructure, financial inclusion, and the governance imperative in development finance’, Ledger: The Salford Journal of Accounting and Finance, 1(1). Available at: https://openjournals.salford.ac.uk/ledger/article/id/416/.

Lewis, W.A. (1954) ‘Economic development with unlimited supplies of labour’, The Manchester School, 22(2), pp. 139–191. doi:10.1111/j.1467-9957.1954.tb00021.x.

M-KOPA (2025) *Pathways to Progress: M-KOPA Impact Report 2025*. Nairobi: M-KOPA.

Mamun, S.M. (2026a) *The Architecture of Strategic Autonomy: Navigating Compute Constraints, Capital Deficits, and Institutional Voids in Sovereign AI for Base of the Pyramid Markets*. Zenodo. doi:10.5281/zenodo.22993445.

Mamun, S.M. (2026b) *The Exhaustion of the Classical Development Toolkit: Aid Transfers, Export-Led Catch-Up and the Labour Ladder under Sovereign AI*. KSCCN article, 10 November 2026. Zenodo. doi:10.5281/zenodo.24125614.

Mamun, S.M. (2026c) *Fluid Institutionalism and the Architecture of Inclusive Artificial Intelligence: A Policy Prescription for the Global South in an Era of Institutional Voids and the Emergence of Artificial General Intelligence*. Zenodo. doi:10.5281/zenodo.22990404.

Mamun, S.M. (2026d) *Reimagining Official Development Assistance: Sovereign AI, Industrial Innovation, and Structural Cooperation Reforms in the Global South*. Zenodo. doi:10.5281/zenodo.23944186.

Mamun, S.M. (2026e) *Simulating Employment Displacement under Partial, Advanced and Near-Full AI and Automation Deployment in Bangladesh’s Ready-Made Garment Factories: A Process-Level Model*. Zenodo. doi:10.5281/zenodo.23282492.

Mamun, S.M. (2026f) *The Sovereign Capability Compact: Re-Engineering Official Development Assistance for Research, Enterprise, and Sovereign AI in the Global South*. Zenodo. doi:10.5281/zenodo.24048235.

Moneycontrol (2025) ‘ONDC extends financial incentives through September as retail orders continue to decline’, Moneycontrol, 11 September. Available at: https://www.moneycontrol.com/technology/ondc-extends-financial-incentives-through-september-as-retail-orders-continue-to-decline-article-13537323.html.

National Payments Corporation of India (NPCI) (2026) *UPI Product Statistics*. Mumbai: NPCI. Available at: https://www.npci.org.in/what-we-do/upi/product-statistics.

OECD (2025) *Securing AI Compute*. Paris: OECD Publishing. Available at: https://www.oecd.org/en/publications/securing-ai-compute_7f96dc99-en/full-report.html.

OECD (2026) ‘International aid fell sharply in 2025, says OECD’. Press release, April. Available at: https://www.oecd.org/en/about/news/press-releases/2026/04/international-aid-fell-sharply-in-2025-says-oecd.html.

OECD.AI (2025) ‘How governments are driving AI adoption for economic growth’, OECD.AI Wonk blog. Available at: https://oecd.ai/en/wonk/how-governments-are-driving-ai-adoption-for-economic-growth.

Partech (2026) *2025 Africa Tech Venture Capital Report*. Paris: Partech, 22 January. Available at: https://partechpartners.com/africa-reports/2025-africa-tech-venture-capital-report.

Press Information Bureau (PIB) (2024) [Press release on the onboarding of fair price shops in Himachal Pradesh on ONDC]. New Delhi: Government of India, 7 February.

Press Information Bureau (PIB) (2025) [Press release on IndiaAI Mission compute capacity and foundation models]. New Delhi: Government of India, 12 October.

RAPID (Research and Policy Integration for Development), as reported in The Daily Star (2025) ‘Garment exports triple in 15 years, but jobs remain stagnant: RAPID’, The Daily Star, 30 November. Available at: https://www.thedailystar.net/business/news/garment-exports-triple-15-years-jobs-remain-stagnant-rapid-4047621.

Rodrik, D. (2016) ‘Premature deindustrialization’, Journal of Economic Growth, 21(1), pp. 1–33. doi:10.1007/s10887-015-9122-3.

Rosenstein-Rodan, P.N. (1943) ‘Problems of industrialisation of Eastern and South-Eastern Europe’, The Economic Journal, 53(210/211), pp. 202–211. doi:10.2307/2226317.

Signé, L. (2026) ‘How to bridge the global AI divide’, Brookings Institution, 8 June. Available at: https://www.brookings.edu/articles/how-to-bridge-the-global-ai-divide/.

Tazhibayev, T.S. (2026) ‘Structural and innovative transformation of Kazakhstan’s metallurgical industry: investment, innovation and sustainable industrial growth’, Bangladesh Journal of Multidisciplinary Scientific Research, 12(1). doi:10.46281/bjmsr.v12i1.2988.

TechCabal (2026) [Report on the launch of Enza Capital’s fund for African AI startups], TechCabal, 2 November.

Tracxn (2026) *SEA Tech Annual Funding Report 2025*. Bengaluru: Tracxn. Available at: https://tracxn.com/d/insights/market-reports/sea-tech-annual-funding-report-2025/.

UNFCCC (2025) [South-South Collective for the Climate (S2C2) initiative document, COP30, Belém]. Bonn: UNFCCC.

Wamda (2026) *2025 Year in Review: Investments in MENA*. Dubai: Wamda, January. Available at: https://www.wamda.com/en/research/2025-year-review-investments-mena.

World Bank (2012) *World Development Report 2013: Jobs*. Washington, DC: World Bank. doi:10.1596/978-0-8213-9575-2.

World Bank (2024) *World Development Report 2024: The Middle-Income Trap*. Washington, DC: World Bank. doi:10.1596/978-1-4648-2078-6.

World Bank (2025) *Digital Public Infrastructure and Development: A World Bank Group Approach*. Digital Transformation White Paper, Vol. 1. Washington, DC: World Bank.

World Bank (2026a) ‘Developing countries’ external debt surges to record $9.4 trillion’. Press release on the International Debt Report 2026, 5 November. Available at: https://www.worldbank.org/en/news/press-release/2026/11/05/developing-countries-external-debt-surges-to-record-9-4-trillion.

World Bank (2026b) *World Development Indicators*. Washington, DC: World Bank. Available at: https://data.worldbank.org (accessed 10 November 2026).

World Economic Forum (2025) ‘How shared digital infrastructure can bridge the gap in Africa’, 9 April. Available at: https://www.weforum.org/stories/2025/04/how-shared-digital-infrastructure-can-bridge-the-gap-in-africa/.

Editorial note and disclaimer

This volume revises a draft research report. Its prose and structure were retained; every statistic and citation was checked against primary or official sources on 10 November 2026, and figures that could not be confirmed were corrected, removed or marked †. A log of all corrections accompanies the deposit. All figures were drawn from the data sources named in their captions; the underlying data files are deposited with the article. The garment-sector figures are model outputs reported in Mamun (2026e). Equation (1) restates the author’s published framing identity. Countries and institutions are named for analytical purposes only. No part of this text constitutes an official position of any government or institution.

The views expressed are those of the author.