Programmable Fiscal Instruments for Welfare Delivery: The Case for Annapurna Coin and a Welfare Digital Public Infrastructure in India

Vidhu Shekhar*

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Abstract

India's welfare architecture has been significantly reshaped over the last decade through digitisation, Direct Benefit Transfers (DBT), and national digital rails such as Aadhaar and the Public Financial Management System (PFMS). These reforms have improved transfer-stage efficiency and reduced diversion at disbursement. However, persistent challenges remain in welfare schemes where policy objectives are outcome-specific, particularly in food security and nutrition. Cash transfers are fully fungible and sensitive to price variation, while in-kind delivery remains administratively rigid and vulnerable to leakage, creating a structural trade-off between efficiency and outcome assurance.

This paper introduces *programmable fiscal instruments* as a distinct class of budget-issued welfare instruments designed to address this gap. Unlike cash transfers, vouchers, or digital currency, programmable fiscal instruments embed purpose, usage constraints, and settlement rules directly within the instrument, enabling outcome-specific welfare delivery without monetary or central-bank balance-sheet implications. The paper situates this concept within a Welfare Digital Public Infrastructure (DPI) framework and argues that instrument design constitutes a missing architectural layer in contemporary welfare systems.

The paper examines *Annapurna Coin* and *Milk Coin* as concrete instantiations of this framework. Annapurna Coin illustrates a population-scale instrument for staple food security, while Milk Coin demonstrates targeted nutrition support for specific demographic groups. Through architectural, legal, and economic analysis, the paper shows how programmable fiscal instruments preserve beneficiary choice while enforcing purpose constraints, support multi-vendor participation, and generate policy-relevant utilisation data. The paper reframes welfare reform as a problem of fiscal instrument design rather than transfer modality.

*SPJIMR Mumbai, vidhu.shekhar@spjimr.org

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1 Introduction: The Welfare Delivery Paradox

Over the last decade, India has undertaken a large-scale transformation of welfare delivery through population-scale digitisation initiatives, including Aadhaar-based identification, Direct Benefit Transfers (DBT), the Public Financial Management System (PFMS), and portability reforms such as One Nation One Ration Card (ONOR). Together, these systems have substantially improved transfer-stage efficiency, reduced diversion at disbursement, and expanded coverage across a large and heterogeneous beneficiary base. India's welfare architecture is therefore frequently cited as a leading example of the use of digital public infrastructure (DPI) in public service delivery.

Yet despite these advances, a persistent structural problem remains. In many welfare schemes—particularly those related to food security, nutrition, health, and human capital formation—the policy objective is not income support per se, but the consumption of specific goods or services. In such settings, improvements in transfer efficiency do not necessarily translate into improved welfare outcomes. The ability of the state to disburse benefits accurately and at scale has advanced considerably; its ability to ensure that expenditure realises intended outcomes has not kept pace. This separation between efficient disbursement and outcome assurance constitutes a central paradox in contemporary welfare delivery.

Existing welfare instruments address this tension only imperfectly. Cash transfers minimise administrative costs and reduce diversion at the point of transfer, but are fully fungible and sensitive to price variation. Once transferred, cash provides no assurance that expenditure aligns with policy objectives, particularly in the presence of competing household needs, intrahousehold allocation dynamics, or supply-side constraints. In-kind delivery mechanisms, such as the Public Distribution System (PDS), preserve purpose specificity through direct provision but rely on physical controls that are costly, rigid, and vulnerable to leakage, storage losses, and local monopolistic structures. Policymakers therefore face a recurring trade-off between administrative efficiency, beneficiary choice, and outcome assurance.

This trade-off is well recognised in the welfare economics literature, which emphasises that welfare outcomes depend not only on the scale of redistribution but also on the design of delivery instruments and institutions [Drèze and Sen, 1990, Sen, 1992]. Empirical studies of food and subsidy programmes in India similarly show that successive reforms have reduced—but not eliminated—last-mile inefficiencies, particularly

where consumption outcomes rather than income support are central to policy intent [Dutta and Ramaswami, 2001, Khera, 2024]. Improvements in identification, payments, and portability have strengthened the welfare delivery rails, but they have not resolved the limitations inherent in instruments that are either fully fungible or operationally rigid.

This paper argues that the persistence of this paradox reflects a missing layer in the current welfare architecture: the design of the welfare instrument itself. Recent reforms have focused primarily on horizontal infrastructure—identity verification, payment systems, and fiscal accounting—while treating the instrument through which welfare is delivered as exogenously given. However, where policy objectives are outcome-specific, instrument design is not neutral. The properties embedded in the instrument governing how entitlements can be used and settled play a decisive role in translating public expenditure into realised welfare outcomes.

To address this gap, the paper introduces *programmable fiscal instruments* as a distinct class of budget-issued welfare instruments. Programmable fiscal instruments embed policy intent directly within the instrument through predefined usage constraints, eligibility rules, and settlement logic. They are non-convertible, non-monetary, and operate entirely within the fiscal domain. By constraining categories of permissible use while preserving beneficiary choice within those categories, such instruments enable outcome-specific welfare delivery without relying on ex post monitoring, behavioural conditionalities, or physical distribution controls.

The paper situates programmable fiscal instruments within a broader Welfare Digital Public Infrastructure (DPI) framework and examines two concrete instantiations: *Annapurna Coin*, designed for population-scale food security, and *Milk Coin*, intended for targeted nutrition support. Together, these cases illustrate how instrument-level programmability can reconcile administrative efficiency with outcome assurance, support multi-vendor participation, and generate policy-relevant utilisation data—without monetary or central bank balance-sheet implications.

The remainder of the paper proceeds as follows. Section 2 situates programmable fiscal instruments within the existing empirical literature on restricted and conditional transfers, highlighting the limits of prevailing approaches. Section 3 then develops a formal definition of programmable fiscal instruments and distinguishes them from existing welfare and monetary instruments. Section 4 places these instruments within a Welfare Digital Public Infrastructure architecture. Section 5.1 examines the design and operation of Annapurna Coin and Milk Coin. Subsequent sections analyse the legal, fiscal, and institutional positioning of such instruments, assess their economic and governance implications, and discuss implementation pathways and risks. The paper concludes by outlining the broader relevance of programmable fiscal instruments for welfare delivery and public finance.

2 Restricted and Conditional Transfers: Limits of Existing Approaches

A substantial empirical literature has examined welfare instruments that restrict the use of transfers, including in-kind provision, vouchers, and conditional cash transfers. This literature establishes that neither unrestricted cash nor tightly controlled in-kind delivery dominates across contexts; rather, outcomes depend on market conditions, household behaviour, and administrative capacity [Cunha, 2014, Banerjee and Duflo, 2013]. Programmable fiscal instruments should be understood within this evidentiary landscape, as a response to the known limitations of existing restricted-transfer mechanisms.

Evidence from the United States on the Supplemental Nutrition Assistance Program (SNAP) and its electronic benefit transfer (EBT) implementation shows that digitisation substantially improves administrative efficiency and reduces certain forms of leakage, while preserving category-based restrictions on eligible goods [Currie, 2003, Hoynes and Schanzenbach, 2009]. However, the literature also documents that SNAP's static category definitions and limited integration with fiscal accounting constrain its ability to adapt to changing policy objectives or generate outcome-relevant expenditure data beyond broad categories [Bitler and Hoynes, 2016].

Experimental and quasi-experimental studies comparing cash and in-kind transfers in low- and middle-income countries similarly yield context-dependent results. Work by Banerjee, Duflo, Cunha, and others finds that in-kind transfers may outperform cash where markets are thin, prices volatile, or specific consumption is underprovided, while cash transfers perform well where markets function effectively and households face fewer constraints [Cunha, 2014, Banerjee and Duflo, 2013]. These findings underscore that the relative effectiveness of instruments depends not only on transfer value, but on how the instrument interacts with market structure and household decision-making.

Conditional cash transfer programmes in Latin America, such as Progresa/Oportunidades and Bolsa Família, demonstrate that outcome alignment can be achieved through behavioural conditionalities linked to health or education outcomes [Fiszbein and Schady, 2009]. However, this approach relies on extensive monitoring, verification, and administrative infrastructure, and often raises concerns regarding exclusion, compliance burdens, and political sustainability.

Evidence from India's own JAM and Direct Benefit Transfer (DBT) reforms reinforces these patterns. While digitisation has significantly reduced transfer-stage leakages and improved inclusion, evaluations consistently show weaker effects on outcome-specific consumption, particularly in nutrition and food security, where fungibility and price variation dilute policy intent [Muralidharan et al., 2023].

Programmable fiscal instruments respond to these limitations not by rejecting restricted-use instruments, but by reconfiguring how restrictions are implemented. Rather than

relying on physical controls, static vouchers, or behavioural conditionalities enforced ex post, they embed purpose, eligibility, and settlement rules directly within the fiscal instrument itself. In doing so, they shift enforcement from beneficiary behaviour and downstream monitoring to instrument-level, ex ante settlement logic, while remaining fully within existing fiscal and institutional frameworks.

3 Conceptual Framework: Programmable Fiscal Instruments

This section defines *programmable fiscal instruments* (PFIs) as a distinct category within welfare delivery and public finance, distinguishes them from existing welfare and monetary instruments, and explains why instrument design is central to welfare outcomes in schemes with consumption-specific objectives.

3.1 Definition and Core Characteristics

Programmable fiscal instruments are budget-issued welfare instruments in which policy intent is embedded directly within the instrument through predefined usage constraints, eligibility conditions, and settlement rules. Unlike conventional transfers that separate entitlement allocation from subsequent consumption, programmable fiscal instruments integrate entitlement, enforcement, and settlement within a single design framework.

An instrument qualifies as a programmable fiscal instrument if it satisfies four necessary conditions.

1. *Purpose-locked*: redemption is restricted to predefined categories of goods or services aligned with the scheme's policy objective.

2. *Non-convertible*: the instrument cannot be exchanged for cash or other monetary instruments and therefore does not constitute general purchasing power.

3. *Fiscally issued*: issuance is authorised through budgetary appropriation and operates entirely within the fiscal domain, without implications for monetary aggregates or central bank balance sheets.

4. *Rule-embedded*: eligibility, usage constraints, validity conditions, and settlement protocols are specified ex ante and enforced automatically at the point of transaction.

Together, these characteristics distinguish programmable fiscal instruments from both fully fungible transfers and operationally rigid in-kind provision. They allow administrative efficiency comparable to digital cash transfers while preserving purpose specificity typically associated with in-kind schemes.

Programmability in this context refers strictly to *ex ante, rule-based enforcement*. It does not imply discretionary control, behavioural monitoring, dynamic intervention, or individualised surveillance at the point of use. Rules are transparent, auditable, and uniformly applied across beneficiaries and vendors.

3.2 Distinction from Existing Welfare and Monetary Instruments

Programmable fiscal instruments differ from established welfare delivery mechanisms along several design and governance dimensions.

Cash transfers, including Direct Benefit Transfers (DBT), are fully fungible and maximise beneficiary discretion but provide no assurance that expenditure aligns with policy objectives once funds are transferred. Their effectiveness therefore depends on household preferences, intrahousehold allocation, market availability, and price stability, limiting their suitability where specific consumption outcomes are central to policy intent.

In-kind delivery mechanisms, such as physical distribution under the Public Distribution System (PDS), embed purpose through direct provision but rely on operational controls rather than instrument-level constraints. This exposes them to storage losses, diversion, inflexibility, and local monopolistic structures, particularly at scale.

Voucher-based systems restrict usage to some extent but are often administratively intensive, static in design, and vulnerable to fraud or arbitrage. Even digital vouchers typically lack real-time settlement discipline and remain weakly integrated with fiscal accounting systems.

Table 1 summarises these differences. The table reports *design characteristics and expected mechanisms*, not empirically established outcomes.

Programmable fiscal instruments are also distinct from digital currency or central bank digital currency (CBDC). CBDCs are sovereign monetary instruments that constitute legal tender and form part of the monetary system. Programmable fiscal instruments, by contrast, are non-monetary entitlements operating within a closed welfare ecosystem. They do not circulate, do not create transferable claims on the state beyond the encoded entitlement, and do not involve monetary settlement at the point of redemption.

The distinction, therefore, is not one of payment technology, but of instrument logic: fungible monetary instruments versus purpose-encoded fiscal entitlements.

3.3 Why Instrument Design Matters in Welfare Economics

The importance of instrument design in welfare policy is well established. Theoretical and empirical work demonstrates that delivery instruments generate distinct incentive effects, administrative costs, and targeting outcomes even when fiscal allocations are held

Table 1: Comparison of Welfare Delivery Instruments (Design Characteristics; Not Empirical Outcomes)

Dimension	**Cash Transfers (DBT)**	**In-kind Delivery (PDS)**	**Vouchers**	**Programmable Fiscal Instruments**
Primary Objective	Income support	Delivery of specific goods	Restricted purchasing power	outcome-specific welfare delivery
Purpose Specificity	None (fully fungible)	High (goods pre-defined)	Medium (restricted categories)	High (embedded in instrument rules)
Beneficiary Choice	High	Low	Medium	High within defined categories
Leakage Exposure	Low at transfer; high at usage	High (diversion, storage losses)	Medium (fraud, arbitrage)	Reduced at redemption through rule enforcement
Administrative Burden	Low	High (logistics, monitoring)	Medium	Low to medium (rule-based enforcement)
Scalability	High	Medium	Medium	High (infrastructure-driven)
Market Structure	Neutral	Often monopolistic	Limited competition	Multi-vendor participation by design
Outcome Alignment	Weak	Moderate	Moderate	Stronger ex ante alignment mechanism
Digital Settlement	Yes	Limited / indirect	Partial	Yes (purpose-linked)
Monetary Nature	Monetary	Non-monetary	Non-monetary	Non-monetary
Examples	PMJDY-linked DBT schemes	Public Distribution System	Food stamps, paper/digital vouchers	Annapurna Coin, Milk Coin

constant [Besley and Coate, 1992, Sen, 1992]. Studies of food and subsidy programmes further show that weak alignment between instrument design and policy objectives leads to leakage, exclusion errors, or outcome dilution irrespective of expenditure levels [Dutta and Ramaswami, 2001].

While allocation determines the scale of redistribution, instrument choice determines how effectively public spending translates into realised outcomes. Fully fungible instru-

ments prioritise flexibility but weaken outcome alignment, while rigid instruments enforce purpose at the cost of administrative burden and limited choice. Programmable fiscal instruments occupy an intermediate design space by preserving beneficiary choice within defined policy-relevant categories. By restricting categories of permissible consumption rather than prescribing vendors or quantities, they support self-selection while maintaining outcome focus.

Embedding constraints at the instrument level reduces reliance on downstream monitoring and ex post enforcement. This shifts welfare administration toward ex ante rule enforcement, lowering informational and governance burdens. Transaction-level data generated through redemption is aligned with policy categories, enabling feedback and learning without intrusive oversight.

3.4 Instrument Design, Capabilities, and Outcome Assurance

From a capabilities perspective, welfare policy is concerned not merely with income transfers but with securing minimum levels of functionings such as nutrition, health, and education. In this framework, the effectiveness of a welfare instrument depends on whether it expands the real freedoms individuals have to achieve these functionings, given prevailing market, social, and household constraints.

Unrestricted cash transfers expand choice sets but do not guarantee that capabilities associated with specific goods—such as adequate nutrition—are realised. Where intra-household allocation dynamics, information asymmetries, social norms, or supply-side constraints are present, additional income may not translate into the intended functionings, even when transfers are well targeted. In such contexts, outcome-specific interventions may expand capabilities more effectively than income support alone.

Conversely, rigid in-kind provision can secure specific commodities but at the cost of choice, dignity, and adaptability, potentially constraining capabilities in other dimensions. The relevant normative question is therefore not whether restrictions are present, but how they are structured.

Programmable fiscal instruments occupy an intermediate position. By restricting categories of permissible use while preserving choice over vendors, brands, quantities, and timing, they aim to secure minimum outcome-relevant consumption without prescribing behaviour or eliminating agency within the defined policy domain. In capability terms, they seek to protect a floor for specific functionings while retaining meaningful choice within that floor.

This design makes explicit the trade-off between autonomy and outcome assurance rather than obscuring it through informal controls or conditionalities. Where the policy objective is consumption-specific—such as nutrition supplementation or access to essential staples—some limitation of fungibility may be normatively justified as a means of

expanding substantive capabilities under real-world constraints.

3.5 Programmability as a Fiscal Attribute

Programmability in programmable fiscal instruments operates entirely within the fiscal domain. Rules governing eligibility, usage, validity, and settlement are determined through budgetary and scheme-level decisions rather than by monetary authorities. Programmability should therefore be understood as an attribute of public expenditure design, not of money.

This distinction preserves institutional clarity. Digital technologies enable rule enforcement, but authority over rule definition and modification rests with the fiscal executive and legislature. As a result, programmable fiscal instruments remain subject to standard principles of public finance—legislative appropriation, audit, and accountability—while remaining outside the scope of monetary policy and currency regulation.

4 Welfare Digital Public Infrastructure (DPI): An Architectural View

Digital Public Infrastructure (DPI) has become central to India's approach to building state capacity at scale. DPIs are population-level digital systems characterised by interoperability, modularity, public governance, and the ability to support multiple public and private services on shared digital rails. Aadhaar for identity, the Unified Payments Interface (UPI) for payments, and the Public Financial Management System (PFMS) for fiscal settlement illustrate how DPI can improve efficiency, inclusion, and reach in public service delivery.

These infrastructures have significantly strengthened the mechanics of welfare delivery. They enable accurate beneficiary identification, reduce diversion at the point of disbursement, and provide traceability of fiscal flows. However, they do not, by themselves, constitute a complete welfare architecture. Existing DPIs are primarily oriented toward identification, authentication, fund transfer, and accounting. They are largely agnostic to how benefits are utilised after transfer, particularly in schemes where policy objectives are defined in terms of specific consumption or service uptake rather than income support.

This distinction is consequential. In welfare programmes targeting food security, nutrition, health, or education, the effectiveness of public spending depends not only on whether benefits reach intended beneficiaries, but on how entitlements are redeemed and translated into outcomes. While digital rails have improved transfer-stage efficiency, they do not resolve the limitations of instruments that are either fully fungible or operationally rigid. As a result, outcome assurance continues to rely on downstream administrative controls or ex post audits, which are costly, imperfect, and difficult to scale.

Figure 1 presents a conceptual Welfare Digital Public Infrastructure architecture that addresses this gap by introducing a purpose-specific layer built atop existing identity and fiscal settlement rails.

Welfare Digital Public Infrastructure (Conceptual Stack)

Layer 1: Identity & Authentication (Horizontal DPI)
Beneficiary and vendor authentication using Aadhaar or alternate identity systems; support for assisted and offline modes

Layer 2: Welfare DPI (Purpose & Rules Layer)
Entitlement engine; programmable fiscal instrument rule modules (eligibility, categories, caps, expiry); consolidated welfare wallet

Layer 3: Fiscal Settlement & Accounting (Horizontal DPI)
PFMS-linked reconciliation; vendor settlement; budget head mapping; audit trail generation

Layer 4: Oversight & Learning
Dashboards; anomaly detection; evaluation; grievance redressal; privacy-aware policy iteration

Interfaces
Beneficiary interfaces (app, SMS, assisted); vendor interfaces (QR, PoS); administrative consoles; analytics APIs

Figure 1: Conceptual Welfare DPI stack highlighting the purpose-specific layer that complements identity and fiscal settlement rails.

Recent research on digital governance and state capacity emphasises that digital infrastructure improves welfare outcomes only when technological systems are aligned with appropriate institutional and instrument design [Gelb and Metz, 2018, Muralidharan et al., 2016]. Evidence from India's DBT reforms similarly indicates that while digitisation substantially reduces transfer-stage leakages, it does not, by itself, ensure outcome alignment in schemes with consumption-specific objectives [Muralidharan et al., 2011]. Comparable findings from other emerging economies suggest that digitised payments improve efficiency but do not guarantee durable inclusion or outcome alignment where usage constraints and accounting integration remain weak.

4.1 DPI Principles and Their Application to Welfare

At a conceptual level, DPIs are guided by principles of universality, interoperability, modularity, openness to innovation, and public oversight. Applied to welfare, these principles imply systems that are accessible across socio-economic groups, interoperable across schemes and jurisdictions, adaptable to diverse programme designs, and governed

through transparent fiscal and legal frameworks.

India's welfare infrastructure already embodies many of these principles. Aadhaar enables portable identity verification; ONOR facilitates inter-state portability of food entitlements; PFMS provides end-to-end visibility of public expenditure flows; and banking and payment interfaces support last-mile delivery. Together, these systems form a robust horizontal backbone for large-scale welfare administration.

However, as horizontal rails, these infrastructures enable the movement of information and funds but do not encode scheme-specific intent. Consumption constraints, eligibility logic, and outcome-relevant rules remain external to the infrastructure and must be enforced through downstream administrative processes. This limitation is especially salient in welfare domains where outcomes depend on specific patterns of consumption or service uptake rather than on income support alone.

4.2 The Missing Layer: Purpose-Specific Digital Settlement

The absence of a purpose-specific settlement layer creates a persistent gap between entitlement delivery and policy outcomes. In the prevailing architecture, entitlements are defined administratively and transfers are executed digitally, but utilisation remains weakly linked to policy intent. Cash transfers may be diverted to non-target uses, in-kind systems rely on physical controls vulnerable to leakage, and policymakers lack timely, structured visibility into how benefits are actually redeemed.

A Welfare Digital Public Infrastructure addresses this gap by introducing a settlement layer explicitly linked to welfare purpose. This layer builds on existing DPIs rather than replacing them. Identity systems authenticate beneficiaries and vendors; fiscal systems handle reconciliation and accounting; and the welfare DPI layer defines the rules governing how entitlements can be redeemed and settled. Instrument design thus becomes an integral component of infrastructure rather than an administrative afterthought.

Purpose-specific digital settlement enables entitlements to be redeemed across multiple authorised providers while preserving policy constraints. It supports beneficiary choice and competition at the point of consumption without relinquishing outcome alignment. Because settlement occurs digitally within the fiscal system, it also generates structured, scheme-relevant data that can inform policy calibration and resource allocation.

4.3 Welfare DPI and Outcome-Oriented Governance

Beyond delivery mechanics, Welfare DPI reshapes how welfare policy is governed and evaluated. Traditional systems operate with limited or delayed information on utilisation, relying on periodic surveys or audits. Purpose-linked digital settlement enables near real-time visibility into aggregate utilisation patterns and regional variation, subject to appropriate privacy safeguards.

This visibility supports a shift from static scheme design toward adaptive policy management. Entitlement parameters, category definitions, or eligibility criteria can be adjusted in response to observed outcomes rather than ex ante assumptions. Because rules are embedded at the instrument level, such adjustments remain transparent and uniformly applied, reducing discretion at the point of delivery.

Importantly, Welfare DPI does not require intrusive monitoring. By limiting data collection to policy-relevant categories rather than individual consumption details, analytical utility can be balanced with privacy and dignity. In this sense, Welfare DPI supports a transition from enforcement-intensive welfare administration toward design-driven governance.

4.4 Institutional Positioning within the Indian State

Welfare DPI is complementary to existing digital infrastructures. It draws on identity, portability, and fiscal settlement systems while adding a layer focused on entitlement logic and outcome alignment. Institutionally, this situates Welfare DPI firmly within the fiscal domain, governed through budgetary processes, scheme guidelines, and legislative oversight.

By framing welfare reform as an infrastructure challenge rather than a programme-specific intervention, Welfare DPI enables instrument-level innovations to be scaled and adapted across schemes. This architectural perspective provides the foundation for programmable fiscal instruments—such as Annapurna Coin and Milk Coin—to operate as interoperable components within a coherent welfare delivery system rather than as isolated policy experiments.

5 Programmable Fiscal Instruments in Practice: Case Studies

This section examines two instantiations of programmable fiscal instruments within a Welfare Digital Public Infrastructure framework. *Annapurna Coin* illustrates application at population scale for staple food security, while *Milk Coin* demonstrates extension to targeted nutrition outcomes. Together, the cases show how programmable fiscal instruments operate as modular, purpose-specific components within a unified welfare architecture, translating abstract design principles into implementable instruments.

5.1 Annapurna Coin: A Programmable Instrument for Food Security

Annapurna Coin is designed as a programmable fiscal instrument to support food security while addressing the limitations associated with both cash transfers and physical in-kind distribution. Its objective is to ensure minimum consumption of essential food staples while preserving beneficiary choice, portability, and administrative efficiency within a digitally governed settlement framework.

5.1.1 Policy Objective and Design Rationale

Food security interventions aim to secure baseline consumption of essential staples rather than to provide general purchasing power. Cash-based approaches offer flexibility but cannot ensure alignment with food consumption, particularly under price volatility, intrahousehold allocation dynamics, or competing household needs. Traditional in-kind systems preserve purpose specificity but rely on physical controls that are costly, rigid, and vulnerable to leakage.

Annapurna Coin addresses this trade-off by embedding food-specific usage constraints directly within the fiscal instrument. The entitlement is issued as a non-convertible digital instrument denominated in quantities of approved food categories rather than in monetary value. Redemption is restricted to specified staple items, preserving purpose specificity while allowing beneficiaries discretion over vendors, brands, and timing of purchase.

5.1.2 Instrument Design, Denomination, and Lifecycle

Annapurna Coin is issued periodically to eligible beneficiaries based on existing welfare databases and entitlement rules. Each unit represents a quantity-denominated entitlement—for example, a fixed number of kilograms of approved staple foods per beneficiary per period—rather than a value-denominated subsidy. This design ensures that fiscal exposure and beneficiary entitlements are determined at the point of issuance, not at the point of redemption.

To illustrate, under India's National Food Security Act (NFSA), priority households are entitled to 5 kilograms of foodgrains per person per month at administratively fixed prices. An equivalent Annapurna Coin entitlement would be denominated as 5 kilograms of approved staple food per eligible individual, redeemable at any authorised vendor. Assuming a vendor commission of Rs. 2 per kilogram for distribution and handling, the fiscal outlay per beneficiary-month equals the government's procurement cost plus a Rs.10 commission—fully specified ex ante through budgetary appropriation.

The instrument incorporates predefined constraints governing eligible item categories, validity periods, and redemption conditions. Unused entitlements may expire or roll

over according to scheme parameters, supporting fiscal discipline. These constraints are enforced automatically at the point of transaction through digital validation, achieving compliance ex ante rather than through downstream inspections. The full lifecycle—from issuance to redemption and settlement—is recorded within the fiscal system.

Figure 2 summarises the end-to-end lifecycle of a programmable fiscal instrument, from budget authorisation to outcome-specific settlement and analytics.

Lifecycle: From Budget to outcome-specific Settlement

1. **Budget Authorisation:** Scheme appropriation and rule parameters defined (eligible groups, categories, caps, validity).
2. **Issuance:** Coins credited to beneficiary welfare wallet.
3. **Redemption Attempt:** Beneficiary initiates purchase at an authorised vendor (online or assisted/offline).
4. **Rule Validation:** System checks eligibility, category compliance, caps, and validity.
5. **Transaction Completion:** Coin balance debited; compliant transaction recorded with minimal policy-relevant fields.
6. **Fiscal Reconciliation:** Transaction mapped to scheme head; audit trail generated.
7. **Vendor Settlement:** Vendor remunerated through fiscal settlement channels.
8. **Analytics and Learning:** Aggregated utilisation data feeds dashboards and evaluation (privacy-aware).

Figure 2: End-to-end lifecycle of a programmable fiscal instrument, highlighting ex ante rule enforcement and fiscal settlement.

5.1.3 Vendor Remuneration, Pricing, and Fiscal Exposure

Vendor settlement under Annapurna Coin is commodity-based rather than value-based. Vendors are remunerated for a distribution function, not paid via the instrument itself. Two settlement models are compatible with the design. Under a commission-based model, vendors deliver the entitled quantity and receive a fixed per-unit commission for handling and retail services. Alternatively, vendors may procure commodities from the public supply system at a discounted reference price, with the discount constituting the retail margin.

In both cases, fiscal exposure is fully determined at the budget stage and insulated from retail price volatility. No monetary payment occurs at the point of redemption, reinforcing the non-monetary nature of the instrument and avoiding the fiscal unpredictability associated with value-indexed reimbursements.

5.1.4 Multi-Vendor Redemption and Portability

Annapurna Coin is redeemable across a network of authorised vendors, including Fair Price Shops and private retail outlets. Redemption is nationally portable by design, interoperating with existing portability infrastructure such as One Nation One Ration Card (ONOR). Identity authentication and entitlement verification occur through shared digital rails, while settlement remains scheme-specific.

This structure introduces competition at the point of delivery and mitigates monopolistic practices, while retaining public control over entitlement parameters, vendor authorisation, and auditability through fiscal settlement systems.

5.1.5 Implications for Food Security Delivery

By combining quantity-denominated entitlements with purpose-locked digital settlement, Annapurna Coin aligns food security objectives with beneficiary choice and portability. It reduces reliance on physical distribution and reframes food security delivery as a problem of instrument design rather than logistics management.

5.2 Milk Coin: A Programmable Instrument for Targeted Nutrition

Milk Coin extends the programmable fiscal instrument framework to targeted nutrition outcomes, particularly for demographic groups such as children and expectant or lactating mothers. Whereas Annapurna Coin addresses population-scale staple access, Milk Coin illustrates how the same infrastructure can support narrower, outcome-specific interventions.

5.2.1 Policy Objective and Targeting Logic

Nutrition interventions often require supplementation targeted at specific groups rather than general food access. Cash transfers are poorly suited to this objective, as intended consumption may be displaced by other household expenditures. Milk Coin addresses this limitation by restricting usage to a defined category of nutrition-relevant items, strengthening the link between fiscal support and intended outcomes.

Eligibility can be defined using demographic, health, or programme participation criteria, allowing Milk Coin to function as an additive and time-bound intervention

alongside broader food security measures.

5.2.2 Instrument Design and Constraints

Milk Coin is issued as a non-convertible, quantity-denominated digital entitlement with embedded usage rules similar in structure to Annapurna Coin but narrower in scope. Redemption is limited to specified nutrition items and may include quantity or frequency constraints aligned with programme objectives.

As with Annapurna Coin, these constraints are enforced digitally and uniformly at the point of transaction, eliminating reliance on beneficiary compliance or ex post verification.

5.2.3 Integration within the Welfare DPI

Milk Coin operates as a modular extension within the same Welfare Digital Public Infrastructure. It uses identical identity, authentication, and settlement rails, differing only in rule configuration. Multiple instruments can therefore coexist within a consolidated welfare wallet while maintaining scheme-specific accounting and governance.

5.2.4 Generalisability of the Framework

The inclusion of Milk Coin demonstrates that programmable fiscal instruments are not limited to staple food delivery. By adjusting eligibility criteria, usage constraints, and validity parameters, the same infrastructure can support a range of outcome-specific interventions without duplicative administrative systems.

Together, Annapurna Coin and Milk Coin illustrate how instrument-level programmability enables differentiated, outcome-oriented welfare delivery within a unified digital framework.

6 Legal, Fiscal, and Institutional Positioning

Programmable fiscal instruments operate squarely within the fiscal domain of the state. Their feasibility and scalability depend on clear legal classification, appropriate budgetary treatment, and a well-defined separation of institutional mandates. This section situates instruments such as Annapurna Coin and Milk Coin within India's constitutional, fiscal, and administrative framework, and clarifies their distinction from monetary and payment instruments.

6.1 Fiscal Nature and Non-Monetary Classification

Programmable fiscal instruments are fiscal entitlements issued pursuant to budgetary appropriations. They do not constitute money, legal tender, or general purchasing

power, and they do not circulate beyond a closed welfare ecosystem. Issuance reflects an expenditure decision authorised through the budget, while redemption represents settlement of that expenditure against approved vendors in accordance with scheme rules.

Accordingly, programmable fiscal instruments do not alter monetary aggregates, do not appear on the central bank's balance sheet, and do not create transferable or open-ended liabilities of the state. The entitlement encoded in the instrument is limited in scope, duration, and permissible use, and lapses according to predefined scheme conditions. Programmability, in this sense, is a fiscal attribute linked to public expenditure design rather than a feature of money or payment systems.

6.2 Budgetary Treatment and Fiscal Accountability

Programmable fiscal instruments can be accommodated within existing budgetary and public financial management frameworks. Entitlements are created through standard scheme allocations authorised by the legislature, and expenditure is recognised upon redemption, when settlement occurs against compliant transactions. Unredeemed or expired entitlements may lapse or be re-appropriated in accordance with scheme design, supporting fiscal discipline and predictability.

Because settlement occurs through government-backed fiscal systems—such as PFMS-linked reconciliation—programmable fiscal instruments generate a clear audit trail from appropriation to utilisation. This strengthens fiscal accountability by aligning expenditure records directly with policy-relevant consumption categories, without requiring parallel accounting systems or ex post reconstruction of usage through surveys or inspections.

Importantly, expiry or non-utilisation of an entitlement does not constitute deprivation of property. Welfare entitlements of this kind are conditional statutory benefits rather than vested property rights, and their scope and duration are determined by scheme design and budgetary authorisation. Transparent rule definition and accessible grievance mechanisms provide procedural safeguards consistent with due process.

6.3 Institutional Roles and Separation of Mandates

Institutional responsibilities under programmable fiscal instruments remain consistent with existing constitutional and administrative arrangements. The legislature and fiscal executive determine scheme objectives, eligibility criteria, and budgetary allocations. Line ministries specify instrument rules—such as eligible categories, caps, and validity—within approved schemes. Implementing agencies manage beneficiary enrolment and vendor authorisation, while technology agencies provide authentication, settlement, and data integration under defined governance standards.

States retain a central role in implementation and oversight in areas of concurrent jurisdiction, including food and nutrition, with scope for contextual adaptation within

nationally defined parameters. This mirrors existing arrangements under schemes such as the Public Distribution System and One Nation One Ration Card.

Monetary authorities remain outside the operational loop. As non-monetary, closed-loop fiscal instruments, programmable fiscal instruments do not constitute payment systems or means of payment between private parties. No monetary consideration is transferred at the point of redemption; vendors are remunerated through separate fiscal settlement channels. This preserves the institutional boundary between fiscal policy and monetary regulation while enabling innovation in welfare instrument design.

Under India's constitutional framework, food and nutrition fall within the Concurrent List, permitting both Union and State legislation. Programmable fiscal instruments operate within this existing distribution of competence: the Union may define national scheme parameters and infrastructure standards, while States retain authority over implementation, vendor authorisation, and contextual adaptation within defined bounds. This mirrors prevailing arrangements under the Public Distribution System and One Nation One Ration Card. From a regulatory standpoint, programmable fiscal instruments do not fall within the perimeter of the Payment and Settlement Systems Act, 2007. No monetary consideration passes between beneficiary and vendor at the point of redemption; vendors are remunerated through separate fiscal settlement channels rather than through the instrument itself. The instrument functions as a closed-loop fiscal entitlement rather than a payment system, and its issuance and settlement remain entirely within the domain of public expenditure management.

6.4 Governance, Oversight, and Dispute Resolution

Governance of programmable fiscal instruments follows standard principles of public expenditure management. Scheme guidelines define eligibility, usage constraints, vendor participation, and settlement procedures. Audit institutions oversee compliance through scheme-aligned records generated by digital settlement, complementing traditional financial and performance audits.

Grievance redressal can be integrated into existing welfare platforms at the beneficiary and vendor levels. Because rules are specified ex ante and applied uniformly, discretion at the point of delivery is limited, reducing scope for arbitrariness, rent-seeking, or discretionary denial of benefits. Disputes can be addressed through administrative review mechanisms without requiring ad hoc intervention.

6.5 Data Governance and Privacy

Transaction data generated through redemption can be limited to policy-relevant fields, such as entitlement category, quantity, timestamp, and settlement identifier. Adherence to

principles of purpose limitation, data minimisation, and transparency enables analytical use for evaluation and policy learning while protecting beneficiary privacy.

Beneficiaries retain visibility into their own entitlement balances and transaction histories, and aggregated, anonymised data supports system-level monitoring and improvement. By avoiding collection of granular consumption or behavioural data, programmable fiscal instruments enable what may be described as privacy-preserving accountability—maintaining auditability and governance without expanding surveillance.

7 Economic and Governance Implications

Programmable fiscal instruments alter welfare delivery by changing how public expenditure is authorised, redeemed, and settled. By embedding purpose and settlement logic at the instrument level, they affect fiscal efficiency, outcome alignment, market structure, administrative capacity, and public financial management. This section examines these implications in mechanism-based terms rather than as empirical claims.

7.1 Fiscal Efficiency and Leakage Exposure

Instrument-level constraints reduce exposure to leakage by enforcing compliance at the point of transaction rather than relying on downstream monitoring. In traditional in-kind systems, leakage arises primarily from diversion, storage losses, and end-point manipulation. In cash-based systems, fungibility weakens alignment between expenditure and policy objectives once funds are transferred.

Programmable fiscal instruments address both channels by permitting settlement only for rule-compliant transactions. Expenditure is realised only when an entitlement is redeemed in accordance with predefined constraints. Unused or expired entitlements do not translate into cash outflows, tightening the link between budgetary allocation and realised expenditure. Over time, this mechanism improves expenditure predictability and reduces the cost per unit of achieved outcome, conditional on effective implementation.

7.2 Outcome Alignment without Behavioural Conditionality

Programmable fiscal instruments strengthen alignment between public spending and intended outcomes by restricting permissible use while preserving beneficiary choice within defined categories. In food and nutrition schemes, policy objectives depend on consumption rather than receipt; category-based constraints improve alignment without prescribing quantities, vendors, or timing of purchase.

Targeted instruments, such as Milk Coin, enable demographic- or time-bound interventions within a common framework. Because compliance is enforced through instrument

rules rather than beneficiary behaviour, such instruments reduce reliance on conditionalities, monitoring, or ex post verification. Outcome alignment is thus achieved through design rather than enforcement intensity.

7.3 Market Structure and Service Provision

By enabling redemption across multiple authorised vendors, programmable fiscal instruments introduce competition at the point of delivery. This mitigates monopolistic tendencies associated with exclusive distribution arrangements and can improve service quality and accessibility, particularly in urban and semi-urban settings.

At the same time, budgetary control is preserved because entitlement parameters, vendor remuneration, and settlement rules remain fiscally defined. Market competition operates within these constraints rather than replacing them. Where market density is limited, public or cooperative provision can coexist with private participation, allowing instrument design to accommodate heterogeneous local conditions.

7.4 Administrative Capacity and Governance

Embedding rules ex ante shifts welfare administration from enforcement-intensive oversight toward design-centric governance. Rather than monitoring compliance after the fact, administrative effort is concentrated on defining eligibility, categories, caps, and settlement parameters at the scheme-design stage.

Digital settlement generates structured, scheme-aligned data on utilisation patterns and regional variation. This improves administrative visibility while limiting discretion at the point of delivery. Uniform rule application reduces opportunities for arbitrary enforcement or rent-seeking and supports more predictable governance of welfare programmes.

7.5 Accounting and Audit Implications

Programmable fiscal instruments have distinctive implications for public sector accounting and audit because usage constraints and settlement rules are embedded at the instrument level. Unlike conventional cash transfers, where expenditure classification and verification occur largely ex post, programmable fiscal instruments enable partial classification, validation, and reconciliation at the point of transaction.

Because entitlements are settled only upon compliant redemption, expenditure records become directly aligned with policy-relevant categories rather than inferred through downstream surveys or audits. This reduces reliance on manual reconciliation and post-hoc verification, lowering audit burdens while improving the informational quality of expenditure data. In effect, a portion of the audit function is shifted upstream into instrument design.

Table 2: Indicative Instrument-Level Accounting Controls

Accounting Control	**Design Mechanism**	**Accounting and Audit Implication**
Purpose-linked usage	Restriction to predefined expenditure categories	Improves accuracy of expenditure classification at source
Time-bound validity	Expiry rules embedded in entitlement	Limits carry-forward ambiguity and simplifies reconciliation
Automated settlement	Settlement only upon rule-compliant transactions	Enables near real-time reconciliation and reduces post-hoc audit effort
Category-level metadata	Recording of transaction category and timestamp	Supports audit verification without granular consumption data
Exception flagging	Rule-based detection of non-compliant attempts	Enables targeted audit review rather than blanket inspection

Crucially, this shift does not require expanded data collection or intrusive monitoring. Accounting relevance can be achieved using limited transaction metadata—such as category codes, quantities, timestamps, and settlement identifiers—while preserving beneficiary privacy. This supports a form of *privacy-preserving accountability*: maintaining verifiable audit trails without granular surveillance of individual consumption behaviour.

From a public financial management perspective, programmable fiscal instruments strengthen fiscal discipline by ensuring that unutilised or expired entitlements do not convert into cash outflows and by enabling timely reconciliation of scheme-level expenditure. These features enhance expenditure predictability and transparency without altering aggregate budgetary aggregates or existing accounting frameworks.

7.6 Learning, Adaptation, and Policy Feedback

Welfare Digital Public Infrastructure enables iterative policy refinement by generating timely, scheme-aligned utilisation signals. Entitlement parameters—such as category definitions, caps, or validity periods—can be adjusted in response to observed patterns rather than relying solely on ex ante assumptions or delayed surveys.

Because such adjustments operate through rule configuration rather than infrastructural change, adaptation does not fragment delivery systems or create parallel schemes. This capacity for learning is particularly valuable in heterogeneous contexts, where consumption patterns, prices, and service availability vary across regions.

Taken together, these mechanisms suggest that programmable fiscal instruments represent a structural evolution in how welfare states translate fiscal resources into social outcomes: shifting emphasis from ex post monitoring toward ex ante design, from discretionary enforcement toward rule-based governance, and from coarse expenditure tracking toward outcome-relevant fiscal information.

8 Implementation Pathway and Pilot Design

The feasibility of programmable fiscal instruments depends not only on conceptual coherence but on implementation within existing administrative, technological, and political constraints. Given the scale and heterogeneity of India's welfare system, phased adoption anchored in piloting and iterative learning is both prudent and institutionally realistic. This section outlines an implementation pathway focused on risk mitigation, institutional compatibility, and evidence generation rather than immediate system-wide replacement.

Rationale for Piloting

Changes in welfare instrument design can generate distributional, behavioural, and operational effects that are difficult to anticipate ex ante. Piloting therefore serves three interrelated functions. First, it validates the technical architecture of programmable fiscal instruments under field conditions, including identity authentication, rule enforcement, and settlement workflows. Second, it enables observation of beneficiary and vendor responses to instrument-level constraints, including uptake, redemption patterns, and service quality. Third, it generates evidence on administrative performance and outcome alignment to inform decisions on scale-up.

Importantly, piloting need not displace existing delivery mechanisms. Parallel operation allows gradual transition, preserves beneficiary trust, and provides fallback options in the event of operational disruption. This reduces political and administrative risk while enabling learning under realistic conditions.

Scope and Design of a Pilot

Pilot design should balance representativeness with manageability. Suitable sites include districts with mixed urban–rural profiles, moderate digital readiness, and established welfare infrastructure, allowing assessment of both online and assisted-offline modes of access.

Within a pilot, *Annapurna Coin* can operate as a population-scale food security instrument, while *Milk Coin* can be introduced as a targeted, additive intervention for eligible demographic groups. This dual-instrument configuration permits evaluation of

both broad-based and narrowly targeted use cases on a shared infrastructure. Vendor participation should include Fair Price Shops as well as private retail outlets, enabling assessment of competition, service quality, and settlement performance across vendor types.

Evaluation Framework

Evaluation should be anchored in indicators aligned with policy objectives and instrument design rather than limited to headline outcome metrics. Core dimensions include system performance (transaction success rates, settlement times), utilisation patterns (redemption frequency, category compliance), vendor participation, and beneficiary experience.

Where feasible, outcome-proximate indicators—such as changes in aggregate consumption of eligible categories—can be tracked, recognising the limits of attribution over short pilot horizons. A baseline–midline–endline structure supports identification of changes associated with instrument design rather than exogenous factors. Qualitative feedback from beneficiaries, vendors, and administrators complements quantitative measures by identifying design frictions and unintended effects. The objective of evaluation is to inform scalable design choices, not to optimise individual metrics in isolation.

Costing and Fiscal Management

Pilot costing should clearly distinguish between fixed or largely amortisable investments in digital infrastructure and scheme-level expenditure associated with welfare entitlements. Platform development, system integration, and capacity building represent shared investments that can support multiple instruments, while entitlement costs remain scheme-specific and time-bound.

This separation enhances fiscal transparency and allows policymakers to assess the marginal cost of introducing additional programmable fiscal instruments once core infrastructure is in place. It also enables comparison with the costs of maintaining parallel delivery systems.

Transition and Scale-Up

Decisions on scale-up should be phased and selective, guided by evidence on operational performance, uptake, and outcome alignment. Programmable fiscal instruments may coexist with traditional mechanisms over extended periods, with relative roles adjusted incrementally. Treating implementation as a learning process rather than a one-time reform supports institutional capacity building and reduces reform fatigue.

9 Risks, Trade-offs, and Safeguards

Programmable fiscal instruments entail risks and trade-offs typical of large-scale welfare reforms. Their value depends on whether design choices mitigate these risks without undermining the core objectives of efficiency, outcome alignment, and inclusion. This section identifies key risk domains and the corresponding safeguards embedded in instrument and system design.

Objections and Responses

Programmable fiscal instruments raise several predictable objections. Addressing these explicitly clarifies both their scope and their limitations.

Vendor market power and price markups. A common concern is that restricted-use instruments create captive demand, enabling vendors to extract rents. In the case of programmable fiscal instruments such as Annapurna Coin, this risk is substantially mitigated by commodity-denominated entitlements and fiscal settlement mechanisms that remunerate vendors through fixed commissions or discounted procurement rather than value-based reimbursement. Because beneficiaries do not tender money and vendor margins are predefined, the primary channel for price markups is constrained. Residual risks—such as quality shading or selective service—are addressed through multi-vendor participation, competition where markets permit, and audit and grievance mechanisms.

Paternalism and loss of autonomy. Restricting use raises concerns about paternalism and diminished agency. Programmable fiscal instruments make this trade-off explicit rather than implicit. They restrict categories of use but preserve choice within categories, allowing beneficiaries discretion over vendor, brand, quantity, and timing. Moreover, targeted instruments such as Milk Coin are designed to be additive and time-bound, complementing rather than replacing general support. In domains where policy objectives are explicitly consumption-specific, some reduction in fungibility may be justified to secure minimum outcomes under real-world constraints.

Political capture of eligible categories. Another concern is that the definition of eligible categories may be subject to rent-seeking or political manipulation. Under programmable fiscal instruments, category definitions are embedded in scheme design and budgetary authorisation, not determined at the point of delivery. This subjects them to legislative scrutiny, transparency requirements, and audit oversight, similar to existing welfare schemes. Periodic review and public disclosure of rule changes further constrain arbitrary expansion or capture.

These objections do not imply that programmable fiscal instruments are universally appropriate, but they delineate the conditions under which such instruments can be designed to balance outcome assurance, agency, and accountability.

Access and Inclusion

Digital delivery introduces exclusion risks arising from uneven access to connectivity, devices, or digital literacy. Mitigation relies on assisted and offline modes of access, integration with existing last-mile intermediaries, and parallel operation during transition phases. These measures reduce the likelihood that technical failures or access barriers translate into benefit denial.

Behavioural Responses and Autonomy

Usage constraints necessarily limit discretion, creating a trade-off between autonomy and outcome alignment. Narrow or overly prescriptive constraints may induce substitution effects or reduce beneficiary welfare. Category-based restrictions that preserve choice across vendors, brands, and timing mitigate this risk by constraining purpose without prescribing behaviour. Time-bound, additive instruments such as Milk Coin further limit distortion by complementing rather than replacing general support.

Privacy and Data Governance

Purpose-linked digital settlement generates transaction data that must be governed carefully to avoid privacy harms. Safeguards include limiting data collection to policy-relevant fields, enforcing purpose limitation and minimisation, and ensuring beneficiary visibility into their own records. Aggregated data can inform evaluation and system improvement without enabling intrusive monitoring or behavioural surveillance.

Institutional and Political Economy Constraints

Reforms may encounter resistance from incumbent intermediaries or administrative actors whose roles are altered by changes in instrument design. Transition-oriented implementation integrates existing delivery agents as authorised vendors and phases change through parallel operation. This approach reduces disruption while realigning incentives toward service provision and compliance.

Operational and Cyber Risks

As with any digital system, programmable fiscal instruments are exposed to operational failures and cyber risks. Redundancy, clear incident response protocols, and fallback arrangements mitigate exposure. Rule-based settlement and automated audit trails enable systematic detection and resolution of anomalies, reducing reliance on discretionary intervention.

Uniformity versus Flexibility

Uniform rule application enhances transparency and predictability but may conflict with local conditions. Modular configuration allows parameters to vary within defined bounds, preserving system coherence while accommodating regional preferences and administrative capacity. Separating core infrastructure from scheme-specific rules enables flexibility without governance fragmentation.

Overall, the performance of programmable fiscal instruments depends less on technological novelty than on careful design, phased adoption, and continuous institutional learning. When implemented with appropriate safeguards, they offer a means of improving outcome alignment without sacrificing inclusion or fiscal discipline.

10 Extending the Framework: From Welfare to Programmable Public Finance

While the preceding sections focus on food security and nutrition as illustrative applications, the conceptual contribution of programmable fiscal instruments extends beyond welfare delivery. In public finance theory, fiscal policy has traditionally been analysed through the functions of allocation, distribution, and stabilisation, with comparatively limited attention to the design properties of expenditure instruments themselves [Musgrave and Musgrave, 1959]. Recent work on outcome-based budgeting, mission-oriented public spending, and digital governance has renewed interest in aligning fiscal tools more closely with policy objectives, creating scope for instrument-level innovation within existing budgetary frameworks [OECD, 2019].

Programmable fiscal instruments contribute to this emerging literature by introducing programmability as a fiscal design attribute rather than a monetary or technological one. By embedding usage constraints and settlement logic directly into budget-issued instruments, they provide a mechanism to link budgetary intent, expenditure realisation, and observed utilisation without altering aggregate fiscal aggregates or institutional mandates. This section situates programmable fiscal instruments within a broader public finance perspective and outlines their implications for expenditure design, evaluation, and state capacity.

10.1 Modularity and Extension across Welfare Domains

Programmable fiscal instruments are modular by design. Once a Welfare Digital Public Infrastructure is in place, additional instruments can be introduced through rule configuration rather than through the creation of parallel delivery systems. Eligibility criteria, usage constraints, validity periods, and settlement parameters can vary across schemes

while relying on shared identity, authentication, and fiscal settlement rails.

This modularity enables extension across welfare domains where policy objectives are outcome-specific. Energy subsidies can be linked to approved fuel purchases, agricultural support to specified inputs, and educational assistance to defined services or materials. In each case, instrument design allows outcome alignment to be pursued without reverting either to unrestricted cash transfers or to logistics-intensive physical provision.

Importantly, modularity does not imply uniformity. Scheme-specific parameters can accommodate regional preferences, seasonal variation, and demographic heterogeneity while preserving common governance, accounting, and audit standards. This balance between differentiation and coherence is difficult to achieve under conventional welfare architectures, where each new scheme often requires a bespoke delivery mechanism.

10.2 Implications for Budget Design and Evaluation

From a public finance perspective, programmable fiscal instruments shift analytical attention from aggregate allocations to the relationship between expenditure design and outcomes. Conventional budgeting systems provide limited visibility into how allocated resources translate into realised consumption or service use, particularly where outcomes depend on beneficiary behaviour after transfer.

When settlement occurs only upon rule-compliant redemption, expenditure data becomes directly relevant to policy objectives. This enhances the informational content of budget execution data and supports performance-oriented evaluation without requiring new budget classifications or parallel reporting structures. Allocations can be compared across instruments and adjusted in response to observed utilisation patterns rather than relying solely on proxy indicators or delayed surveys.

Crucially, this approach complements rather than replaces existing fiscal frameworks. Programmable fiscal instruments do not alter aggregate expenditure ceilings, fiscal rules, or budgetary authority. Instead, they improve the fidelity with which budgetary intent is translated into realised expenditure, strengthening the link between public finance and policy outcomes.

10.3 State Capacity and Policy Learning

Embedding rules at the instrument level reduces reliance on ex post enforcement and monitoring, shifting administrative effort toward ex ante design and calibration. This reallocation of effort improves transparency and predictability while limiting discretion at the point of delivery.

Data generated through Welfare Digital Public Infrastructure supports iterative policy learning by providing timely, scheme-aligned signals on utilisation and uptake. Because rule configuration can be adjusted within defined bounds, policymakers can refine eligibility

criteria, category definitions, or validity parameters in response to changing conditions without fragmenting delivery systems or creating parallel schemes. This supports shared governance between central and subnational authorities while maintaining system-wide coherence.

10.4 Global Relevance

The challenges addressed by programmable fiscal instruments—leakage, weak outcome alignment, and administrative complexity—are common across welfare systems in developing and middle-income countries. India's experience with Digital Public Infrastructure demonstrates that it is possible to export governance frameworks rather than discrete applications.

Welfare Digital Public Infrastructure, built around programmable fiscal instruments, extends this approach by separating infrastructure from scheme design and embedding policy intent at the instrument level. As such, it offers a replicable model adaptable to diverse institutional contexts and contributes to broader debates on social protection, fiscal innovation, and digital state capacity.

11 Conclusion

This paper has examined a persistent challenge in welfare delivery: improvements in transfer efficiency do not guarantee outcome achievement when policy objectives are consumption-specific. While digital public infrastructure has substantially improved the accuracy and scale of welfare disbursement, it has not resolved the limitations of delivery instruments that are either fully fungible or operationally rigid. The resulting trade-off between efficiency, flexibility, and outcome assurance remains a central problem in contemporary welfare systems.

To address this gap, the paper introduced *programmable fiscal instruments* as a distinct class of budget-issued welfare instruments that embed policy intent directly within instrument design. By encoding usage constraints and settlement rules ex ante, such instruments enable outcome-specific welfare delivery without relying on behavioural conditionalities, intrusive monitoring, or monetary programmability. Situated within a Welfare Digital Public Infrastructure framework, programmable fiscal instruments constitute a missing architectural layer between digital delivery rails and policy outcomes.

The cases of *Annapurna Coin* and *Milk Coin* illustrated how instrument-level programmability operates in practice. Together, they show how outcome alignment can be strengthened while preserving beneficiary choice, enabling multi-vendor participation, and generating policy-relevant utilisation data within a unified digital architecture. These cases are illustrative rather than exhaustive, but they demonstrate the feasibility of treating

welfare reform as a problem of instrument design rather than of transfer modality alone.

Beyond specific schemes, the analysis highlights broader implications for public finance and state capacity. By tightening the linkage between budgetary intent, expenditure realisation, and observed utilisation, programmable fiscal instruments enhance the informational content of public spending and support design-driven governance. Their effectiveness, however, depends on careful rule definition, phased implementation, and robust institutional safeguards rather than on technological novelty.

As welfare delivery increasingly relies on digital public infrastructure, the central question is not whether welfare systems will be digital, but how digital architectures can be aligned with policy intent. Programmable fiscal instruments, embedded within a Welfare Digital Public Infrastructure, offer one approach to addressing this alignment challenge in outcome-oriented welfare delivery.

References

[Banerjee and Duflo, 2013] Banerjee, A. and Duflo, E. (2013). Poor economics. a radical rethinking of the way to fight global poverty. *Society and Economy*, 35(4):573–587.

[Besley and Coate, 1992] Besley, T. and Coate, S. (1992). Workfare versus welfare: Incentive arguments for work requirements in poverty-alleviation programs. *The American Economic Review*, 82(1):249–261.

[Bitler and Hoynes, 2016] Bitler, M. and Hoynes, H. (2016). The more things change, the more they stay the same? the safety net and poverty in the great recession. *Journal of Labor Economics*, 34(S1):S403–S444.

[Cunha, 2014] Cunha, J. M. (2014). Testing paternalism: Cash versus in-kind transfers. *American Economic Journal: Applied Economics*, 6(2):195–230.

[Currie, 2003] Currie, J. (2003). *US food and nutrition programs*. University of Chicago Press.

[Drèze and Sen, 1990] Drèze, J. and Sen, A. (1990). *Hunger and public action*. Clarendon Press.

[Dutta and Ramaswami, 2001] Dutta, B. and Ramaswami, B. (2001). Targeting and efficiency in the public distribution system: Case of andhra pradesh and maharashtra. *Economic and Political Weekly*, pages 1524–1532.

[Fiszbein and Schady, 2009] Fiszbein, A. and Schady, N. R. (2009). *Conditional cash transfers: reducing present and future poverty*. World Bank Publications.

[Gelb and Metz, 2018] Gelb, A. and Metz, A. D. (2018). Identification revolution: Can digital id be harnessed for development? Technical report.

[Hoynes and Schanzenbach, 2009] Hoynes, H. W. and Schanzenbach, D. W. (2009). Consumption responses to in-kind transfers: Evidence from the introduction of the food stamp program. *American Economic Journal: Applied Economics*, 1(4):109–139.

[Khera, 2024] Khera, R. (2024). Impact of the food security act on public distribution system. *Perspectives*.

[Muralidharan et al., 2011] Muralidharan, K., Niehaus, P., and Sukhtankar, S. (2011). Assessing the scope for cash transfers in lieu of the tpds in rural and urban bihar. *J-PAL South Asia*, 5:25.

[Muralidharan et al., 2016] Muralidharan, K., Niehaus, P., and Sukhtankar, S. (2016). Building state capacity: Evidence from biometric smartcards in india. *American Economic Review*, 106(10):2895–2929.

[Muralidharan et al., 2023] Muralidharan, K., Niehaus, P., and Sukhtankar, S. (2023). General equilibrium effects of (improving) public employment programs: Experimental evidence from india. *Econometrica*, 91(4):1261–1295.

[Musgrave and Musgrave, 1959] Musgrave, R. A. and Musgrave, R. A. (1959). *The theory of public finance: A study in public economy*, volume 658. McGraw-Hill New York.

[OECD, 2019] OECD (2019). Oecd good practices for performance budgeting.

[Sen, 1992] Sen, A. (1992). *The political economy of targeting*. World Bank Washington, DC.

A Supplement Conceptual Diagrams

A.1 Welfare Wallet and Multi-Coin Portfolio

Consolidated Welfare Wallet (Conceptual View)

The welfare wallet functions as a consolidated interface for scheme-specific entitlements while preserving separate accounting and rule sets. A single beneficiary may hold multiple coins simultaneously.

Example portfolio in a welfare wallet:

- **Annapurna Coin:** Staples and food security categories (population-scale entitlement)
- **Milk Coin:** Targeted nutrition category (demographic or time-bound supplement)
- **(Extensible) Other Coins:** Clean cooking fuel, education, agricultural inputs, etc.

Common wallet functions:

- Entitlement balances by coin type; validity/expiry alerts
- Transaction history (beneficiary-visible); grievance initiation
- Vendor discovery; assisted/offline access options

Governance separation:

- Each coin maintains scheme-specific rules and budgetary mapping
- The wallet provides a unified interface without merging scheme accounts

Figure 3: Conceptual depiction of a consolidated welfare wallet holding multiple programmable fiscal instruments with scheme-specific rules.

B Pilot KPI Definitions

This appendix outlines indicative Key Performance Indicators (KPIs) for evaluating a pilot implementation of programmable fiscal instruments. The KPIs are designed to assess technical feasibility, administrative performance, beneficiary experience, and outcome alignment, rather than to function as rigid targets.

KPIs should be interpreted jointly rather than in isolation. The objective of pilot evaluation is to identify design strengths, frictions, and trade-offs that inform scalable

Table 3: Indicative Pilot KPIs for Programmable Fiscal Instruments

KPI Category	**Indicator**	**Description**
System Performance	Transaction success rate	Proportion of attempted transactions successfully authenticated, validated, and settled
System Performance	Settlement time	Time elapsed between transaction validation and vendor settlement
Coverage and Access	Beneficiary activation rate	Share of eligible beneficiaries who successfully redeem entitlements during pilot period
Coverage and Access	Offline / assisted transaction share	Proportion of transactions conducted through assisted or offline modes
Vendor Ecosystem	Vendor participation density	Number of authorised vendors per defined geographic unit
Vendor Ecosystem	Vendor transaction share	Distribution of transactions across vendor types (FPS, kirana, others)
Beneficiary Experience	Beneficiary satisfaction score	Survey-based assessment of ease of use, choice, and reliability
Outcome Alignment	Category-compliant utilisation	Share of expenditure aligned with defined eligible item categories
Administrative Efficiency	Grievance incidence rate	Number of grievances per 1,000 transactions
Administrative Efficiency	Resolution turnaround time	Average time to resolve beneficiary or vendor grievances

implementation, rather than to optimise individual metrics.

C Costing Summary

This appendix presents a high-level costing framework for a pilot implementation of programmable fiscal instruments. The purpose is to distinguish between (i) one-time or largely fixed investments in digital public infrastructure, and (ii) scheme-specific expenditure associated with welfare entitlements. This separation is critical for fiscal transparency and for assessing the marginal cost of extending the framework to additional schemes.

By isolating platform-related costs from scheme expenditure, policymakers can evaluate the long-term fiscal implications of programmable fiscal instruments. Once core infrastructure is established, the incremental cost of introducing additional instruments is

Table 4: Indicative Costing Structure for Pilot Implementation

Cost Category	**Nature**	**Description**
Digital Platform Build	Capital	Core welfare wallet, entitlement engine, rule configuration modules, and system integration
Identity and Settlement Integration	Capital	Integration with identity authentication, public financial management, and settlement systems
Capacity Building and Change Management	Revenue	Training of officials, vendor onboarding, beneficiary awareness and support
Operations and Support	Revenue	Helpdesk, monitoring, grievance redressal, and system maintenance during pilot
Evaluation and Learning	Revenue	Baseline–midline–endline evaluation, surveys, and concurrent assessment
Scheme-Level Entitlements	Revenue	Time-bound welfare expenditure delivered through programmable fiscal instruments
Vendor Participation Support	Revenue	Transitional incentives or support for vendor onboarding during pilot phase

expected to be substantially lower than that of launching parallel delivery systems.