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Programmable Money and the Future of Monetary Policy Transmission: Mechanisms, Vulnerabilities, and Macroeconomic Implications

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Abstract

Programmable money—central bank digital currencies, tokenised deposits and stablecoins whose behaviour can be conditioned by embedded code—is moving from experiment to infrastructure. As these instruments spread, the question for monetary authorities is no longer whether they will exist but how they will alter the transmission of monetary policy. This paper addresses that question through a qualitative research design. It applies qualitative document analysis and thematic synthesis to a purposively selected body of peer-reviewed studies, central bank and international organisation reports, and legal texts published between 2017 and mid-2026, complemented by an illustrative case of Vietnam. The analysis yields an instrument-neutral framework in which four design dimensions—remuneration, deposit mobility, convenience and currency of denomination—shape the interest rate, bank lending, implementation and exchange rate channels. Four

propositions emerge. Programmable money is neutral for credit conditions only where banks can replace lost deposits without friction. The strength and predictability of pass-through depend on how closely the remuneration of programmable money follows the policy rate. Highly convenient or foreign-currency programmable money tightens financial conditions structurally and imports foreign monetary conditions, a mechanism termed here digital dollarisation. Finally, extensive programmability of public money erodes the trust on which transmission relies. The paper maps four vulnerabilities—structural disintermediation, run dynamics, digital dollarisation, and operational or governance failure—onto these channels and discusses the implications for output, inflation and financial stability, particularly in emerging economies. It concludes that the monetary consequences of programmable money are a matter of design rather than of technology.

Keywords: Programmable Money, Central Bank Digital Currency, Stablecoins, Tokenised Deposits, Monetary Policy Transmission

1. Introduction

Money is becoming software. In recent years, three families of digital instruments have acquired the ability to carry executable logic alongside value: central bank digital currencies (CBDCs), tokenised commercial bank deposits and privately issued stablecoins. The development is no longer marginal. Stablecoins have grown from a niche settlement asset for crypto trading into a sizeable segment of the market for money-like claims (Bank for International Settlements [BIS], 2026) ^[11]. The large majority of central banks are exploring a retail CBDC, a wholesale CBDC or both, and many have accelerated that work in response to stablecoins (Illes *et al.*, 2025) ^[33]. The United States gave payment stablecoins a federal statutory basis in 2025 (Congressional Research Service, 2026) ^[21], while the BIS has set out a blueprint in which tokenised central bank reserves, commercial bank money and government bonds coexist on a unified programmable ledger (BIS, 2025) ^[10].

These developments matter for monetary policy because transmission runs through the instruments that households and firms use as money. A change in the policy rate reaches the real economy only after it has altered deposit rates, bank funding costs, loan pricing, asset prices and exchange rates (Mishkin, 1995; Bernanke & Gertler, 1995) ^[43, 13]. Each of these links depends on the structure of the market for money-like claims, and in particular on the market power that banks enjoy over deposits (Drechsler *et al.*, 2017) ^[25]. Programmable money changes that structure along several margins at once. It alters who issues money-like claims, how quickly holders can switch between them, whether the claim bears interest, and in which currency it is denominated.

The literature has addressed parts of this problem. A first strand studies CBDC and finds that its effects on bank intermediation

range from neutral to expansionary or contractionary, depending on market structure and on whether the central bank passes funds back to banks (Brunnermeier & Niepelt, 2019; Andolfatto, 2021; Chiu *et al.*, 2023; Keister & Sanches, 2023; Abad *et al.*, 2025) [19, 7, 20, 37, 1]. A second, very recent strand examines stablecoins and documents effects on government bill markets, bank funding and loan supply (Ahmed & Aldasoro, 2025; Altavilla *et al.*, 2026; Hofmann *et al.*, 2026) [5, 6, 31]. A third compares stablecoins with tokenised deposits from the perspective of the singleness of money and narrow banking (Garratt & Shin, 2023; Huang & Keister, 2026) [28, 32].

Three gaps remain. First, these strands have evolved largely in isolation, each tied to one instrument, although the instruments compete for the same balances and differ along a small number of common design dimensions. Second, the field is dominated by formal models and calibrations, whereas the institutional, legal and design choices that determine how programmable money actually operates have received little systematic qualitative attention. Programmability in particular is usually treated as a technical attribute and not as an economic variable. Third, most contributions focus on the United States or the euro area, whereas the sharpest policy trade-offs arise in emerging economies exposed to foreign-currency digital money.

This paper addresses these gaps through three research questions:

1. Through which mechanisms does programmable money modify the interest rate, bank lending, implementation, exchange rate and expectations channels of monetary policy?
2. Which vulnerabilities does it introduce into those channels, and under what conditions do they become macroeconomically relevant?
3. What are the implications for output, inflation and financial stability, and how do they differ for small open emerging economies?

The paper makes four contributions. It proposes an instrument-neutral framework that describes any form of programmable money by four design dimensions: remuneration, deposit mobility, convenience and currency of denomination. It synthesises a fragmented body of evidence through qualitative document analysis and distils it into four propositions that reconcile the apparently conflicting neutrality and disintermediation results in the literature. It maps four classes of vulnerability onto the

transmission channels, showing where design choices amplify or dampen them. Finally, it draws policy implications for emerging economies, using Vietnam, which has recently legislated on digital assets while keeping fiat-referenced tokens outside its pilot regime, as an illustrative case.

The remainder of the paper is organised as follows. Section 2 defines programmable money and reviews the literature. Section 3 sets out the research design and the analytical framework. Sections 4 and 5 present the findings on transmission mechanisms and vulnerabilities. Section 6 discusses the propositions and their macroeconomic implications. Section 7 derives policy implications, and Section 8 concludes.

2. Conceptual background and literature review

2.1 Defining programmable money

The term programmable money is used loosely, and the looseness obscures the economics. Lee (2021) [40] defines it as a single coherent product that encapsulates both a digital store of value and the logic that governs that value. The Monetary Authority of Singapore (2023) [44] refines this by separating three concepts. In *programmable payments*, the logic sits outside the money and merely triggers a transfer when conditions are met, as in a standing order. In *programmable money*, the logic is embedded in the token and travels with it. In *purpose-bound money*, a programmable wrapper restricts how an underlying digital currency may be spent until specified conditions are satisfied, after which the unrestricted money is released.

This paper adopts a broad, instrument-neutral definition: programmable money is any digital monetary claim whose transfer, remuneration or usability can be conditioned by code executed on the ledger on which the claim is recorded. The definition is deliberately wider than the purpose-bound case, because the monetary consequences arise mainly from two less controversial capabilities. The first is automated, rule-based remuneration and limits. The second is composability, meaning that the claim can be combined with other tokenised assets in atomic, round-the-clock transactions (BIS, 2023, 2026) [9, 11].

2.2 The instrument landscape

Four instruments currently satisfy this definition. They differ in issuer, backing, remuneration and the locus of programmability, as Table 1 summarises.

Table 1: Principal forms of programmable money

Instrument	Issuer and nature of claim	Backing	Remuneration	Locus of programmability
Retail CBDC	Central bank; direct liability to the public	Central bank balance sheet	Typically none, or tiered	Mainly conditional payments offered by intermediaries; purpose restrictions generally ruled out
Wholesale CBDC and tokenised reserves	Central bank; liability to eligible institutions	Central bank balance sheet	Policy-linked	Smart-contract execution of settlement and policy operations
Tokenised deposits	Commercial bank; deposit claim	Loans and securities, with deposit insurance and lender-of-last-resort access	May bear interest	Bank-governed smart contracts on permissioned ledgers
Fiat-backed stablecoins	Mostly non-banks; redeemable claim on the issuer	Treasury bills, repos and bank deposits	None from the issuer under the US GENIUS Act	Open and composable on public blockchains

Sources: Author's synthesis based on BIS (2025, 2026) [10, 11], Congressional Research Service (2026) [21], Garratt and Shin (2023) [28] and Monetary Authority of Singapore (2023) [44].

The distinction between stablecoins and tokenised deposits is more than legal. Stablecoins are bearer instruments that circulate in secondary markets and can trade away from par, whereas tokenised deposits settle between banks in central bank money and therefore preserve the singleness of money (Garratt & Shin, 2023) ^[28]. The BIS (2025) ^[10] argues that stablecoins fall short on singleness, elasticity and integrity, the three tests of a sound monetary system, and that a unified ledger anchored in central bank reserves is the superior architecture. Stablecoins are nevertheless the fastest-growing segment, are almost entirely denominated in US dollars, and are dominated by a very small number of issuers (Schnabel, 2026) ^[48].

2.3 CBDC and monetary transmission

The theoretical literature on CBDC starts from an equivalence result. Brunnermeier and Niepelt (2019) ^[19] show that a swap of deposits for CBDC leaves allocations unchanged if the central bank passes the funds back to banks, a result that Niepelt (2024) ^[46] extends to an economy with reserves and bank market power. Departures from neutrality arise from market structure and frictions. Andolfatto (2021) ^[7] and Chiu *et al.* (2023) ^[20] find that when banks have deposit market power, an interest-bearing CBDC acts as an outside option that raises deposit rates and can expand rather than shrink intermediation. Keister and Sanchez (2023) ^[37] and Williamson (2022) ^[51] emphasise the opposite trade-off between payment efficiency and bank funding, while Fernández-Villaverde *et al.* (2021) ^[26] show that a central bank competing for deposits may become a deposit monopolist. Agur *et al.* (2022) ^[4] derive the optimal design as a balance between preserving payment variety and protecting bank intermediation.

Model-based macroeconomic studies reach similarly conditional conclusions. Barrdear and Kumhof (2022) ^[12] obtain sizeable steady-state output gains from CBDC issuance against government bonds, and Bordo and Levin (2017) ^[16] argue that an interest-bearing CBDC would relax the effective lower bound. Abad *et al.* (2025) ^[1] show, in a New Keynesian model calibrated to the euro area, that CBDC adoption drains reserves and gradually moves the operational framework from a floor towards a corridor and eventually a ceiling system, with modest real effects. Adalid *et al.* (2024) ^[2] conclude that material effects on lending emerge only in the presence of collateral or liquidity frictions. In open economies, CBDC strengthens international spillovers and reduces monetary autonomy abroad (Ferrari Minesso *et al.*, 2022; Cova *et al.*, 2026) ^[27, 22]. Surveys by Auer *et al.* (2022) ^[8], Infante *et al.* (2022) ^[34] and Das *et al.* (2023) ^[23] consolidate these findings.

2.4 Stablecoins, tokenised deposits and the recent evidence

Early work viewed stablecoins through the lens of free banking and run-prone private money (Gorton & Zhang, 2023) ^[29] and studied the arbitrage that sustains their peg (Lyons & Viswanath-Natraj, 2023) ^[42]. Since 2025 the focus has shifted to macro-financial effects. Ahmed and Aldasoro (2025) ^[5] show that inflows into stablecoins depress short-term US Treasury bill yields, with stronger effects under market stress. Using granular euro area data, Altavilla *et al.* (2026) ^[6] find that stablecoin adoption shifts bank funding from retail deposits to wholesale sources, alters pass-through in ways that depend non-linearly on adoption and

design, and weakens domestic transmission when the stablecoins are in foreign currency. Hofmann *et al.* (2026) ^[31] identify two opposing forces, a contractionary bank lending channel and an expansionary fiscal space channel, with the former dominating in the long run. Huang and Keister (2026) ^[32] show that the welfare ranking of stablecoins and tokenised deposits depends on regulatory costs and risk-taking incentives, reviving the narrow banking debate. Kim *et al.* (2026) ^[38] and Liao and Caramichael (2022) ^[41] demonstrate that the consequences for reserve demand and credit hinge on the composition of stablecoin backing. For emerging economies, Adrian *et al.* (2025) ^[3] warn that foreign-currency stablecoins facilitate currency substitution and erode monetary sovereignty.

2.5 Synthesis

Two regularities emerge. Results that appear contradictory across instruments become consistent once the instruments are described by common design dimensions, above all remuneration and the ease of switching out of deposits. In addition, frictions in wholesale bank funding are the pivot on which neutrality turns into non-neutrality. The research design in Section 3 is built to examine both regularities systematically.

3. Research design and method

3.1 A qualitative approach

The paper adopts a qualitative research design. Three features of the subject justify this choice. Programmable money is an emerging phenomenon whose adoption is still unfolding, so that consistent time series are short, heterogeneous across jurisdictions and partly proprietary. Its monetary effects depend on institutional and legal design choices, which are documented in texts and not in statistics. And the research questions ask how and under what conditions transmission changes, which is the natural domain of qualitative inquiry. The study is therefore conceived as an integrative review that synthesises existing knowledge into a new framework and a set of propositions (Torraco, 2005; Snyder, 2019) ^[50, 49], in the manner of a theory-synthesis conceptual article (Jaakkola, 2020) ^[35].

3.2 Sources and selection

The evidence consists of documents, analysed following the principles of qualitative document analysis (Bowen, 2009) ^[17]. Three categories of source were used. The first comprises peer-reviewed research on CBDC, stablecoins, tokenised deposits and monetary transmission. The second comprises institutional documents: reports, working papers, experimental project reports and speeches issued by central banks, the BIS and the International Monetary Fund. The third comprises legal and regulatory texts, notably the United States stablecoin statute and the Vietnamese legal instruments on digital assets.

Selection was purposive. A document was included if it addressed monetary policy transmission or the design of programmable money directly, originated from an authoritative academic or official source, and was published between 2017 and mid-2026; foundational works on the transmission mechanism and on bank runs were added irrespective of date. Diversity of instrument and of jurisdiction was sought deliberately, so that findings on one form of programmable money could be compared with findings on another. The full set of documents analysed is

given in the reference list.

3.3 Analytical procedure

The documents were examined by thematic analysis (Braun & Clarke, 2006) [18]. After familiarisation with the material, each document was coded deductively against the channels of monetary transmission established in the literature (Mishkin, 1995; Bernanke & Gertler, 1995) [43, 13]. A second, inductive round of coding identified the design features and risks that the authors themselves regarded as decisive. The coded material was then compared across instruments in order to locate convergent claims, divergent claims and the conditions that account for the divergence. Finally, the recurring design features were abstracted into four dimensions, and the conditional regularities were formulated as propositions.

The Vietnamese case is used as an illustrative single case (Yin, 2018) [52]. It was chosen because Vietnam is a bank-based emerging economy that has recently adopted legislation on digital assets. The case rests on legal documents, and its purpose is analytical illustration, not statistical generalisation.

3.4 Trustworthiness and limits

Credibility was pursued in three ways. Claims were triangulated across the three categories of source, so that no finding rests on a single type of document. Disconfirming evidence was sought actively: where sources disagree, the disagreement is reported together with the conditions that explain it. And the analysis is transparent, since every source is publicly available and cited. The design also has limits. The synthesis is interpretive and was conducted by a single researcher, no primary data such as interviews with policymakers were collected, and the field is evolving quickly, so that the conclusions are provisional.

3.5 Analytical framework

The thematic analysis produced the framework shown in Fig 1, which structures the presentation of findings in the following sections.

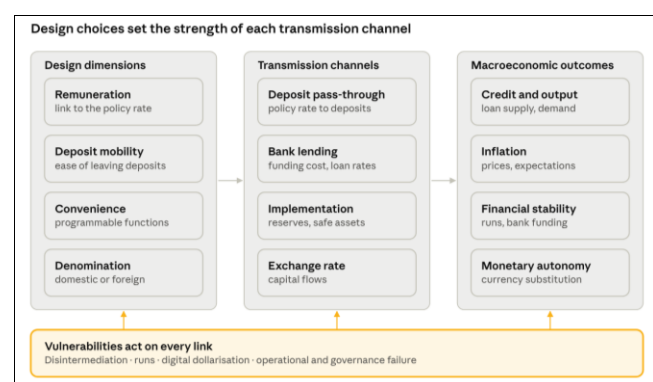


Fig 1: Conceptual framework: design dimensions, channels, outcomes

Fig 1. Conceptual framework. The design dimensions of programmable money govern the transmission channels, which in turn drive macroeconomic outcomes; vulnerabilities operate on every link. Source: author's elaboration.

Four design dimensions recur across the documents, whatever the instrument under discussion. *Remuneration*

refers to whether, and how closely, the return paid to holders of programmable money follows the policy rate; unremunerated stablecoins and cash-like CBDC lie at one end of the spectrum, and tokenised claims indexed to the policy rate at the other. *Deposit mobility* is the ease with which balances move between bank deposits and programmable money; instant convertibility and automated sweeps increase it, whereas holding limits reduce it. *Convenience* denotes the non-pecuniary advantages of programmable money over deposits, such as composability with other tokenised assets, conditional payments and continuous settlement. *Denomination* indicates whether the instrument is issued in domestic or in foreign currency. These dimensions shape the transmission channels, and the channels in turn drive macroeconomic outcomes. Vulnerabilities can arise at every link. Section 4 reports the findings on the channels, Section 5 those on the vulnerabilities, and Section 6 draws them together in four propositions.

4. Findings: Transmission mechanisms

The thematic analysis identified five channels through which programmable money modifies transmission, together with a sixth, more tentative, mechanism. Table 2 provides an overview, and the subsections develop each theme.

Table 2: Programmable money and the channels of monetary transmission

Channel	Conventional mechanism	Effect of programmable money	Decisive design dimension
Interest rate (deposit pricing)	Sluggish, incomplete pass-through owing to deposit market power	Faster and fuller pass-through if remunerated; unchanged or weaker if not	Remuneration
Bank lending	Policy alters the quantity and cost of bank funding	Shift towards wholesale funding; stronger but less predictable pass-through	Deposit mobility
Safe assets and yields	Policy rate anchors short-term yields	Reserve demand of issuers moves bill yields independently of the policy stance	Backing rules
Policy implementation	Reserves, standing facilities and open market operations	Less stable reserve demand; automated, continuous operations	Backing rules and ledger design
Exchange rate	Interest differentials move capital flows and the currency	Faster portfolio shifts; foreign monetary conditions enter domestic funding costs	Denomination

Source: Author's synthesis of the documents analysed.

4.1 The interest rate channel

Bank deposit rates respond slowly and incompletely to policy rates because depositors face switching costs and banks exploit them (Drechsler *et al.*, 2017) [25]. The documents agree that programmable money attacks both sources of inertia. Automated sweeps and instant

convertibility lower switching costs, and a remunerated alternative sets a floor under deposit rates. Chiu *et al.* (2023) [20] accordingly find that an interest-bearing CBDC disciplines deposit pricing, and Andolfatto (2021) [7] reaches the same conclusion for a monopolistic banking sector.

The decisive question is therefore what programmable money actually pays. Retail CBDC projects are mostly designed without remuneration, and the GENIUS Act prohibits issuers from paying interest on payment stablecoins, although affiliated platforms may compensate customers separately (Congressional Research Service, 2026) [21]. Effective remuneration is thus partly the outcome of regulatory arbitrage and not of policy design. Tokenised deposits and tokenised money market fund shares, in contrast, can index returns automatically to the policy rate. An ecosystem dominated by unremunerated instruments would leave the interest rate channel largely unchanged and could reinforce the effective lower bound (Schnabel, 2026) [48]. One dominated by remunerated instruments would make deposit rates track the policy rate almost mechanically.

4.2 The bank lending channel

The bank lending channel operates when policy affects the quantity and price of funding that banks cannot costlessly replace (Kashyap & Stein, 2000) [36]. Programmable money alters the composition of that funding. The euro area evidence of Altavilla *et al.* (2026) [6] shows that stablecoin adoption pushes banks from retail deposits towards wholesale sources. The sources converge on two consequences. Lending conditions become tighter at any given policy rate, because wholesale funding is more expensive and less stable than retail deposits. And the response of lending to policy changes becomes stronger, since marginal funding is priced in markets, yet also less predictable, since it now varies with adoption, market liquidity and regulation (Altavilla *et al.*, 2026; Schnabel, 2026) [6, 48].

The literature also explains why some studies find no effect at all. Where banks can replace lost deposits at an unchanged cost, for instance because the central bank recycles the funds, the composition of bank funding is irrelevant for credit (Brunnermeier & Niepelt, 2019; Niepelt, 2024) [19, 46]. Material effects on lending arise only in the presence of collateral or liquidity frictions (Adalid *et al.*, 2024) [2].

The destination of the migrating balances matters as well. If stablecoin issuers hold reserves as bank deposits, funds return to the banking system, but as large, uninsured and concentrated wholesale deposits in place of stable retail funding (Liao & Caramichael, 2022) [41]. If reserves are invested in government bills, the deposits pass to the sellers of those bills and are redistributed across banks. Tokenised deposits avoid the problem by keeping programmability inside the banking perimeter (Huang & Keister, 2026) [32]. The lending channel is consequently reshaped more by stablecoins and retail CBDC than by tokenised deposits.

4.3 Safe assets and the yield curve

Fiat-backed stablecoins transform payment balances into demand for short-term government paper. Ahmed and Aldasoro (2025) [5] show that flows into stablecoins lower short-term Treasury bill yields without affecting longer maturities. The effect is modest compared with policy decisions, but it grows with the sector and is unrelated to the

policy stance. The result is a wedge between the policy rate and the yields at which governments and money market investors transact. Hofmann *et al.* (2026) [31] interpret this as a fiscal space channel that provides short-run stimulus while the bank lending channel restrains credit over time. For the central bank, flows into and out of programmable money become a new source of noise in money market conditions.

4.4 Policy implementation

Programmable money changes the demand for central bank reserves and the tools used to supply them. Abad *et al.* (2025) [1] show that as CBDC adoption grows, reserves decline and the operational framework drifts from a floor system towards a corridor and ultimately a ceiling, in which banks depend on central bank credit. For stablecoins, the effect depends on backing: reserve demand declines if issuers hold bank deposits, is broadly unchanged if they hold reserves directly, and shifts to government bill markets if they hold bills (Kim *et al.*, 2026) [38]. In each case the central bank faces a larger and less predictable autonomous factor.

Programmability also offers new instruments. Project Pine demonstrated that a central bank could implement interest on reserves, open market operations and collateral management through smart contracts on a tokenised platform, adjusting the terms instantly and operating continuously (BIS Innovation Hub & Federal Reserve Bank of New York, 2025) [15]. Implementation could thus become faster and more granular, for example through tiered remuneration that changes automatically with balances. The counterpart is that liquidity can move at any hour, which requires facilities and collateral frameworks that function outside conventional operating times.

4.5 The exchange rate channel

In open economies the denomination dimension dominates. When residents can hold foreign-currency programmable money, the foreign interest rate and expected depreciation enter domestic funding conditions directly. A domestic rate cut that raises expected depreciation may induce outflows from deposits and tighten credit conditions, the reverse of the intended effect. Ferrari Minesso *et al.* (2022) [27] and Cova *et al.* (2026) [22] reach consistent conclusions for foreign CBDC, and Altavilla *et al.* (2026) [6] find that banks reliant on foreign-currency wholesale funding respond less to domestic policy. Since stablecoins are almost exclusively dollar-denominated, the exchange rate channel becomes faster and less controllable, and capital flow measures that rely on regulated intermediaries are easier to circumvent (Adrian *et al.*, 2025) [3].

4.6 Expectations and direct transfers

Two further mechanisms appear in the documents, though less prominently. Purpose-bound designs make it technically possible to distribute transfers that expire or can be spent only on specified goods (Monetary Authority of Singapore, 2023) [44], which would raise the propensity to spend out of such transfers. This is a fiscal instrument executed on monetary rails, and most central banks have excluded it from retail CBDC because it compromises the fungibility of money. Programmable ledgers also generate timely transaction information that can sharpen the assessment of economic conditions and, through clearer communication, support the expectations channel. Both mechanisms are

constrained by privacy and legitimacy, which Section 5 addresses.

5. Findings: Vulnerabilities

The inductive coding grouped the risks discussed in the documents into four classes. Table 3 links each to its trigger, the channel it impairs and the design features that mitigate it.

Table 3: Vulnerabilities of programmable money and mitigating design features

Vulnerability	Typical trigger	Channel most affected	Mitigating design
Structural disintermediation	High convenience combined with low deposit rates	Bank lending	Holding limits, tiered remuneration, central bank refinancing
Run dynamics	Doubts about reserve assets or bank solvency; automated redemptions	Policy implementation, safe assets	High-quality liquid backing, enforceable redemption rights, settlement in central bank money
Digital dollarisation	Inflation and depreciation expectations	Exchange rate, interest rate	Denomination rules, a credible domestic digital alternative
Operational and governance failure	Code errors, cyber incidents, contested usage restrictions	All channels	Audited code, resilience standards, legal limits on programmability

Source: Author's synthesis of the documents analysed.

5.1 Structural disintermediation

The first vulnerability is slow, not sudden. As programmable money becomes more convenient, deposits migrate permanently and banks replace them with more expensive and less stable funding. Credit becomes costlier at any given policy rate, which amounts to a structural tightening of financial conditions. The effect is easily overlooked because it changes the level of lending rates and leaves their responsiveness to policy intact. Hofmann *et al.* (2026) ^[31] conclude that widespread stablecoin adoption modestly reduces long-run output through this channel. The risk for policy is one of misdiagnosis: a central bank that does not recognise that the neutral policy rate has shifted downwards will run an unintentionally restrictive stance.

5.2 Run dynamics and the singleness of money

The second vulnerability is abrupt. Any money-like claim backed by assets that are less liquid or less certain than the claim itself is exposed to runs (Diamond & Dybvig, 1983) ^[24]. Stablecoins share this fragility with the private bank notes of the free banking era (Gorton & Zhang, 2023) ^[29], and the arbitrage that normally sustains their peg can fail under stress (Lyons & Viswanath-Natraj, 2023) ^[42]. The temporary loss of the peg by a major stablecoin in 2023, when part of its reserves was held at a failing bank, illustrated the mechanism (Schnabel, 2026) ^[48]. Because issuers hold government bills, forced sales transmit the shock to the market in which monetary policy is implemented (Ahmed & Aldasoro, 2025) ^[5].

Programmability amplifies the speed of such episodes. Redemptions can be executed at any hour, and smart contracts that liquidate positions automatically when thresholds are breached synchronise the behaviour of holders. Deposit mobility is therefore not constant: it rises sharply in periods of stress. The same logic applies to retail CBDC, which offers a safe destination for flight from bank deposits (Fernández-Villaverde *et al.*, 2021) ^[26]. This is the rationale for holding limits and tiered remuneration (Bindseil, 2020; Kumhof & Noone, 2021) ^[14, 39]. When different forms of money cease to exchange at par, the unit of account fragments and the policy rate no longer prices a single monetary asset.

5.3 Digital dollarisation

The third vulnerability concerns monetary sovereignty. Traditional dollarisation required access to foreign banknotes or foreign-currency accounts. Dollar stablecoins remove this barrier, since a mobile phone suffices to hold them. Adrian *et al.* (2025) ^[3] document the rapid spread of stablecoin holdings in Latin America, Africa and the Middle East, and the BIS (2026) ^[11] warns that widespread digital currency substitution could sharply curtail domestic monetary policy autonomy. Once residents hold their liquid balances in a foreign unit, the domestic policy rate ceases to govern the return on those balances, and foreign monetary conditions are imported. The process is subject to hysteresis, because network effects make a payment unit difficult to dislodge once it is established.

5.4 Operational and governance risks

The fourth class is non-financial but macroeconomically relevant. Monetary logic encoded in software inherits the weaknesses of software: coding errors, dependence on external data feeds and exposure to cyber-attacks. Concentration compounds the problem, because a shared ledger or a dominant issuer is a single point of failure for payments and for policy implementation alike. Pseudonymous public blockchains also weaken safeguards against illicit finance (BIS, 2025) ^[10].

Governance risk is subtler. The capacity to restrict how money is spent conflicts with fungibility and privacy, which underpin public trust in money. If households suspect that balances may be conditioned or monitored, adoption of public digital money will remain low and demand will shift to private or foreign alternatives over which the central bank has less influence. Excessive programmability of public money could therefore weaken the transmission it was meant to improve.

These vulnerabilities interact. A run on a dollar stablecoin would disturb government bill markets, tighten dollar funding for emerging market banks and trigger further substitution away from local currencies. Risk assessment therefore has to proceed at the level of the system and not instrument by instrument.

6. Discussion: Propositions and macroeconomic implications

6.1 Four propositions

Read together, the findings on channels and vulnerabilities support four propositions. They are stated in qualitative terms and are intended as hypotheses for subsequent empirical work.

Proposition 1 (conditional neutrality): Programmable

money is neutral for credit conditions where banks can replace lost deposits at an unchanged cost. It affects lending only where wholesale funding is scarce, costly or constrained by collateral.

This proposition reconciles the equivalence results (Brunnermeier & Niepelt, 2019; Niepelt, 2024) ^[19, 46] with the disintermediation results (Keister & Sanches, 2023; Altavilla *et al.*, 2026) ^[37, 6]. The two bodies of work do not contradict each other; they describe economies with different funding frictions.

Proposition 2 (design-dependent pass-through): The more closely the remuneration of programmable money follows the policy rate, the stronger and more predictable the pass-through of policy to deposit and lending rates. Where programmable money is unremunerated, greater deposit mobility makes pass-through weaker or more erratic. The reasoning is that, with an unremunerated instrument, a policy tightening raises the relative return on deposits, draws balances back into banks and eases their funding, which offsets part of the tightening. With a remunerated instrument this reflux does not occur and the policy impulse is transmitted in full. The proposition explains why digital money is reported both to strengthen and to weaken transmission (Chiu *et al.*, 2023; Schnabel, 2026) ^[20, 48].

Proposition 3 (structural tightening and digital dollarisation): Highly convenient programmable money tightens financial conditions independently of the policy stance. If it is denominated in foreign currency, it additionally imports foreign monetary conditions and lowers the effectiveness of domestic policy.

Proposition 4 (the trust constraint): The more extensively public money is made programmable at the retail level, the lower public trust and adoption, and the weaker the central bank's leverage over the monetary system.

Propositions 3 and 4 follow from the vulnerabilities described in Section 5 and define the boundary within which the potential benefits of Proposition 2 can be realised.

6.2 Output and credit

The propositions distinguish a lasting effect on the level of financing conditions from an effect on their responsiveness to policy. The first is the structural tightening of Proposition 3. Its direction is not in doubt, but the sources agree that its magnitude is likely to be modest (Abad *et al.*, 2025; Hofmann *et al.*, 2026) ^[1, 31]. Offsetting forces exist. Lower government borrowing costs create fiscal space in the short run (Hofmann *et al.*, 2026) ^[31], CBDC issued against government debt can reduce real interest rates (Barrdear & Kumhof, 2022) ^[12], and cheaper cross-border payments raise efficiency (Kim *et al.*, 2026) ^[38]. The net effect on output thus depends on where the migrating balances are reinvested and on whether the central bank accommodates the shift by lowering its assessment of the neutral rate.

6.3 Inflation and the conduct of policy

The second effect concerns stabilisation. Where programmable money is remunerated and mobile, Proposition 2 implies that a given change in the policy rate has a larger effect on lending rates, so that smaller policy moves achieve the same influence on demand and inflation. Where it is unremunerated, the response is weaker and, more importantly, variable, since it depends on adoption and on funding market conditions. Uncertainty about the strength of transmission is a cost in its own right, because it

complicates the calibration of policy and favours gradualism.

The effective lower bound illustrates the asymmetry. Unremunerated programmable money is a digital equivalent of cash that is cheaper to store and to transfer in large amounts. It therefore raises the floor below which deposit rates cannot fall and reinforces the lower bound (Schnabel, 2026) ^[48]. A remunerated CBDC could in principle remove the bound (Bordo & Levin, 2017) ^[16], but only if it displaced cash and other unremunerated digital claims, a condition that is unlikely to hold while private stablecoins circulate.

6.4 The nexus between monetary policy and financial stability

Programmable money tightens the link between the two mandates. Faster runs require liquidity facilities that operate continuously and accept a wider range of collateral. A larger structural recourse to central bank funding, as in the ceiling system described by Abad *et al.* (2025) ^[1], expands the central bank's footprint in credit allocation. Adalid *et al.* (2024) ^[2] note that the central bank balance sheet prevents a system-wide funding shortage, but the distribution of liquidity across banks may still deteriorate. The risk is a form of financial dominance, in which concern for the stability of non-bank money issuers constrains interest rate decisions.

6.5 Emerging and small open economies

The implications are sharper for emerging economies, for three reasons that correspond to the design dimensions. Wholesale funding markets are shallow, so the frictions that turn neutrality into non-neutrality under Proposition 1 are more severe. Confidence in the domestic currency is more fragile, so depreciation expectations are volatile. And foreign-currency instruments offer high convenience as a store of value. Proposition 3 then implies imported monetary conditions and weaker pass-through, which narrows a policy space already limited by the open-economy trilemma.

Vietnam illustrates the trade-offs. Its financial system is bank-based, the State Bank of Vietnam relies on credit growth targets and a managed exchange rate alongside interest rates, and the economy has a history of dollarisation that the authorities have worked to reverse. The policy response to digital money has been sequenced. In 2021 the government tasked the central bank with studying and piloting a blockchain-based digital currency (Prime Minister of Vietnam, 2021) ^[47]. The Law on Digital Technology Industry, in force since January 2026, recognises digital assets while excluding legal tender in digital form from that category (National Assembly of Vietnam, 2025) ^[45]. Resolution 05/2025/NQ-CP established a time-limited pilot market for crypto assets in which transactions must be conducted in Vietnamese dong and tokens backed by fiat currencies are not permitted (Government of Vietnam, 2025) ^[30]. In terms of the framework, this regime fixes the denomination dimension and limits deposit mobility within the regulated perimeter. Its weakness is that offshore and peer-to-peer use of dollar stablecoins remains outside that perimeter, so the exposure identified in Proposition 3 is contained and not eliminated.

7. Policy implications

The central message is that the monetary effects of programmable money are chosen, not given. Six principles

follow from the analysis.

1. **Treat remuneration as a monetary policy parameter:** Proposition 2 indicates that remuneration determines whether programmable money strengthens or weakens transmission. Rules on interest payments should therefore be set with the monetary authority and applied consistently across CBDC, tokenised deposits and stablecoins, including rewards paid by affiliated platforms. Tiered remuneration offers a way to combine strong pass-through at the margin with protection of bank funding (Bindseil, 2020) ^[14].
2. **Anchor programmable money in central bank settlement:** Singleness is a precondition for a meaningful policy rate. Architectures built on tokenised reserves and tokenised deposits preserve it (Garratt & Shin, 2023; BIS, 2025) ^[28, 10]. Where stablecoins are permitted, full backing with high-quality liquid assets and enforceable redemption at par are minimum requirements.
3. **Use quantity limits as a macroprudential instrument:** Holding limits restrain deposit mobility and blunt the pull of convenience. Their calibration should be rule-based and transparent, because discretionary changes in a crisis could themselves signal distress.
4. **Protect monetary sovereignty through denomination policy and credible alternatives:** Restrictions on foreign-currency tokens are effective only within the regulated perimeter. They need to be complemented by efficient domestic instruments, such as instant payment systems and local-currency tokenised deposits, that reduce the relative convenience of foreign digital money, and by cross-border supervisory cooperation.
5. **Constrain the programmability of public money by law:** In line with Proposition 4, conditional logic belongs at the level of payments and wholesale operations. A statutory guarantee that retail central bank money will not carry spending restrictions, together with strong privacy safeguards, protects fungibility and the trust on which adoption depends.
6. **Adapt the operational framework and the analytical toolkit:** Central banks should prepare continuous liquidity facilities, monitor the composition of bank funding and the reserve portfolios of issuers, and reassess the strength of pass-through and the neutral rate as adoption progresses.

For emerging economies, sequencing is essential. Regulation that precedes large-scale adoption is far less costly than attempts to reverse entrenched currency substitution. In the Vietnamese case, the existing pilot regime provides a controlled environment. Three complementary steps appear warranted: systematic monitoring of residents' use of stablecoins, experimentation with dong-denominated tokenised deposits under supervisory oversight, and continued preparatory work on a central bank digital currency as a contingency instrument. Each step narrows the convenience gap that drives substitution without committing the authorities to a specific end state.

8. Conclusion

Programmable money changes monetary policy transmission through the design of the instruments, not through the technology as such. Using qualitative document

analysis, this paper has shown that four design dimensions—remuneration, deposit mobility, convenience and denomination—are sufficient to organise a literature that is otherwise fragmented by instrument. The synthesis yields four propositions. Programmable money is neutral for credit conditions only where banks can replace lost deposits without friction. The strength and predictability of pass-through rise with the degree to which its remuneration follows the policy rate. Convenient or foreign-currency programmable money tightens financial conditions structurally and imports foreign monetary policy. And extensive programmability of public money undermines the trust on which transmission depends. These propositions reconcile the neutrality and disintermediation findings of earlier work and explain why recent studies report transmission becoming at once stronger and less predictable. The associated vulnerabilities, namely structural disintermediation, runs, digital dollarisation and operational or governance failure, are also functions of design. They are most acute where wholesale markets are shallow and confidence in the currency is fragile, which places emerging economies at the centre of the policy debate.

The study has limitations. It relies on published documents and on the interpretive judgement of a single researcher, it collects no primary data, and its propositions are qualitative. Three avenues for future research follow. The first is to complement the documentary evidence with interviews of central bank officials, bank treasurers and issuers, in order to capture practitioner perspectives on design choices. The second is comparative case research across emerging economies that have adopted different regulatory regimes for digital money. The third is the empirical testing of the four propositions as adoption proceeds and longer, more consistent records become available.

9. Declarations

Data Availability: The study is based exclusively on publicly available documents, all of which are listed in the references. No datasets were generated or analysed.

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