JOURNAL OF ECONOMIC SCIENCES: THEORY AND PRACTICE, V.82, # 2, 2025, pp. 96-116

A DSGE FRAMEWORK FOR SOVEREIGN DIGITAL CURRENCY ADOPTION IN SMALL OPEN ECONOMIES: MACRO-FINANCIAL CHANNELS, BANK INTERMEDIATION, AND POLICY TRADE-OFFS

Nazim Hajiyev[1,2] (Corresponding author), Daniyar Aliyev[3]

[1] Department of Business Management, UNEC Business School, Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan, AZ1001
ORCID ID - 0000-0002-3093-2322, n.hajiyev@unec.edu.az
[2]Development Economics Research Center, UNEC Business School, Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan, AZ1001
[3] Elite Gymnasium, Baku, Azerbaijan, ORCID ID - 0009-0002-0891-7334, privnoy@gmail.com

https://doi.org/10.30546/jestp.2025.82.02.2021

Received: June 06; accepted October 02, 2025; published online December 16, 2025

ABSTRACT

We build a tractable small-open-economy Dynamic Stochastic General Equilibrium (DSGE) model with monopolistically competitive banks to study the macro-financial effects of introducing a sovereign digital currency (SDC) - here modeled as an account-based central bank digital currency (CBDC). Households choose between bank deposits and SDC holdings; banks finance loans largely with deposits and face a reduced-form intermediation capacity. Mechanism — higher attractiveness of an interest-bearing SDC mechanically substitutes away bank deposits, reducing bank funding and, absent recycling, shrinking loan supply and lowering aggregate credit. Quantitatively, under our baseline calibration a 10% reallocation from bank deposits into SDC implies an≈3.2% contraction in bank lending and a consumption-equivalent welfare loss of ≈0.039% (worst-case scenarios reach ≈8.0% welfare loss when recycling is absent and intermediation is fragile). Policy experiments show that (i) modest or tiered remuneration on SDC, (ii) limits/tiering on holdings, and (iii) active central-bank recycling of inflows into bank funding substantially mitigate credit and welfare losses. Our results are robust across parameter sweeps. Policy implication — combining tiered remuneration with credible recycling is the most effective way to preserve credit while delivering the liquidity and payment-system benefits of SDC. Limitations — the analysis is theoretical, uses a reduced-form banking block and illustrative calibration; country-level empirical calibration and endogenous bank-risk dynamics are left for future work.

Keywords: SDC, CBDC, Small Open Economy, DSGE, Bank Intermediation.

JEL codes: E52, E44, F41, G21

INTRODUCTION

The possibility that central banks will issue sovereign digital currencies (SDCs), i.e., general-purpose digital central-bank liabilities available to households and firms, has generated intense macroeconomic and financial debate. Theoretical work shows that SDCs can expand liquidity services and discipline bank deposit market power (Fernández-Villaverde et al., 2021; Burlon, Muñoz and Smets, 2024), but may also cause bank disintermediation and contraction in bank lending unless design choices and central-bank balance-sheet actions compensate for funding shortfalls (Infante et al., 2023).

Note: "DSGE" = Dynamic Stochastic General Equilibrium; "SDC" = Sovereign Digital Currency; "CBDC" = Central Bank Digital Currency; "UIP" = Uncovered Interest Parity; "NFA" = Net Foreign Assets. All acronyms are spelled on first use.

International and policy authorities emphasize that design — interest provisioning, holding limits, tiering, and recycling of liabilities — is crucial for outcomes (BIS, 2021; IMF, 2023; IMF, 2025b). Small open economies face particular vulnerabilities: shallower banking sectors, higher deposit reliance, and greater sensitivity to cross-border capital flows make SDC design choices potentially more consequential than in large, closed economies. Motivated by these considerations, this paper builds a tractable DSGE framework that explicitly models: household payment demand across instruments; monopolistic banks that intermediate deposits into loans; a central bank issuing SDC with explicit recycling rules; and an external sector that transmits SDC adoption through uncovered interest parity and cross-border flows.

Our contribution is threefold. First, we introduce a compact, analytically tractable small-open-economy DSGE framework that explicitly models household payment demand, monopolistically competitive banks that intermediate deposit into loans, and a modular SDC design space (remuneration, tiering, cross-border usability) together with central-bank recycling rules and balance-sheet responses. Second, we derive both decentralized and planner equilibria and obtain closed-form comparative statics and welfare expressions that identify parameter thresholds (for remuneration, tiering and recycling) under which SDCs raise or reduce welfare. Third, with attention to the small open-economy context, we show how exchange-rate and capital-flow channels amplify intermediation trade-offs and demonstrate which policy levers—modest or tiered remuneration, explicit holding limits, and credible recycling commitments—are most effective at mitigating lending losses without surrendering liquidity-service gains. The remainder of the paper is organized as follows: Section 2 reviews the literature; Section 3 sets out the model; Section 4 derives equilibrium conditions and steady states; Section 5 presents the calibration and numerical experiments; Section 6 reports analytical results and welfare implications; Section 7 contains robustness checks and extensions; Section 8 discusses operational considerations; Section 9 provides policy takeaways; Section 10 concludes. Appendices A–C provide full derivations, numerical methods and compact extensions.

Why a small open economy? Small open economies are especially sensitive to deposit substitution because of shallower capital markets and higher deposit reliance; treating the world rate as exogenous allows us to focus on exchange-rate and capital-flow channels that amplify SDC adoption effects.

LITERATURE REVIEW

The paper contributes to three strands of literature: (i) the theoretical DSGE literature on central-bank digital currencies and their macroeconomic effects, (ii) the literature on bank intermediation, deposit substitution, and financial stability, and (iii) work on small open economies, capital flows and exchange-rate transmission that motivates our calibration and policy focus.

DSGE and theoretical CBDC literature.

A growing theoretical literature introduces central-bank digital currencies (CBDC / SDC) into New Keynesian and monetary frameworks to quantify trade-offs between liquidity services and bank disintermediation. Early quantitative DSGE contributions include Barrdear and Kumhof (2016), who study the macroeconomic consequences of a universally accessible, interest-bearing CBDC, and Fernández-Villaverde et al. (2021), who analyze the design trade-offs and stability implications of CBDC in dynamic settings.

Keister and Sanches (2021) formalize the trade-off that CBDC brings greater payment efficiency but may crowd out bank deposits and hence lending; they provide conditions under which a CBDC is welfare-improving. Several recent papers extend this framework by explicitly modeling banks' balance sheets, collateral frameworks, and optimal central-bank responses (see Barrdear & Kumhof, Keister & Sanches, and related work).

More recent quantitative work provides welfare and policy rules in calibrated DSGE settings. For example, Burlon, Muñoz and Smets (2024) use a DSGE model calibrated to a large advanced economy and find a non-trivial welfare-maximizing CBDC size (their baseline range is 15–45% of quarterly GDP), highlighting the importance of collateral and central-bank balance-sheet choices for policy design.

Working papers, and policy-oriented surveys within them, synthesize these model-based findings and emphasize that design choices (remuneration, tiering, caps, and recycling) and operational constraints matter crucially for the banking system and monetary transmission. See BIS and recent central bank working papers for an overview.

Banking, deposit substitution and financial stability

Our model builds on theoretical literature on deposit demand, bank intermediation and fragility. Classic works on liquidity provision and runs (Diamond and Dybvig) motivate modeling deposit convenience and the role of banks as liquidity transformers. Recent papers on CBDC emphasize that even moderate remuneration or increased convenience can induce deposit substitution, raising banks' funding costs and affecting lending (e.g., Keister & Sanches; Fernández-Villaverde et al.). This literature motivates our modeling of deposit demand elasticities and the bank pricing FOCs.

Small open economies, capital flows and exchange-rate transmission

Small open economies face distinct constraints—higher deposit reliance, shallower capital markets, and stronger sensitivity to cross-border capital flows—which can amplify SDC-induced effects. Empirical country-level studies in *Economic Sciences: Theory & Practice* document exchange-rate pass-through and the structure of bank deposits in small open economies; for Azerbaijan and comparable economies, Rahimov and Jafarova (2021) document strong exchange-rate pass-through to CPI components, motivating our open-economy treatment and the emphasis on central-bank reserves and recycling.

Policy and applied work in the same journal discuss digital currencies and stablecoins in regional practice; Taghiyev et al. (2021) analyze stablecoins' institutional features and contrasts to fiat liabilities, which helps motivate the tiering and interoperability parameters in our design space.

MODEL

We present a log-linearizable New-Keynesian DSGE model with a banking sector and SDC. Time is discrete and infinite, $t = 0,1,2, \dots$. All agents are price takers except monopolistically competitive firms and banks where specified. Lower-case letters denote logs when variables are log-linearized.

Households

A representative household maximizes expected discounted utility:

$$\max_{\{C_t, I_t, B_t, D_t, S_t\}} E_0 \sum_{t=0}^{\infty} \beta^t [u(C_t) - \frac{\phi}{2} L_t^2],$$
(1)

subject to the period budget constraint:

$$P_t C_t + Q_t I_t + D_t + S_t = W_t L_t + (1 + i_t^b) D_{t-1} + (1 + i_t^s) S_{t-1} + \Pi_t + (1 + r_t) B_{t-1} - T_t. \quad (2)$$

Where:

- C_t: consumption.
- I_t: investment, Q_t its price.
- D_t: nominal bank deposits held at the end of period t.
- S_t: nominal SDC holdings (central bank liability) held at end of period t.
- B_t: foreign bonds (open-economy asset).
- i_t^b: deposit interest rate (banks pay).
- i_t^s: SDC remuneration rate (central bank sets).
- r_t: return on foreign bonds (exogenous world rate plus premium).
- Another standard notation applies.

Households use both deposits and SDC for payments and as stores of value. The payment services and convenience yield from each instrument are imperfect substitutes. Following standard practice, we model transactions-technology based money-in-utility or cash-in-advance friction; here we use a generalized transactions cost that implies demand for liquid assets (deposits and SDC).

The household first-order conditions yield stochastic Euler equations and liquidity demand relations. In particular, the (log) relative demand for SDC vs deposits depends on the relative remuneration $(i_t^s - i_t^b)$, the convenience yields, and parameters governing substitutability.

Banks

Banks accept deposits D_t, pay interest i_t^b, hold reserves and lend them to firms L_t. Banks are monopolistically competitive in deposit markets (markup over marginal cost), capturing deposit market power. The bank profit maximization problem:

$$\max_{i_t^b} \Pi_t^b = (1 + i_t^l) L_t - (1 + i_t^b) D_t - \quad operating\ costs(D_t, L_t), \quad (3)$$

where i_t^l is the lending rate. Deposit demand elasticity is finite, so SDC competition (if attractive) will force banks to raise deposit rates, affecting net interest margins and loan supply.

Banks face balance sheet constraint:

$$L_t = \theta(D_t + O_t), \tag{4}$$

where O_t are other funding sources (e.g., wholesale). The parameter θ captures maturity transformation capacities; lower θ limits lending per unit of deposits.

Banks also face regulatory capital constraint; they choose i_t^b taking into account expected loan returns and default risk.

Firms and Prices

A continuum of monopolistically competitive firms produces differentiated goods. Prices are set under Calvo stickiness: each firm can reoptimize with probability $1 - \xi_p$, which yields the standard New-Keynesian Phillips curve after aggregation. The goods market clears

$$Y_t = C_t + I_t + G_t + NX_t; \tag{5}$$

Investment and capital accumulation follow standard laws of motion. These assumptions supply the Phillips-curve and output-gap ingredients used in Section 4 (equations (A14)–(A15) in the appendix).

SDC design, monetary policy and central-bank balance sheet

This subsection consolidates the SDC design choices and the monetary-policy / central-bank balance-sheet representation used in the model and in the numerical exercises. We state these design choices explicitly so the reader can reproduce the comparative statics and numerical experiments.

SDC design choices (model implementation)

In the baseline model the sovereign digital currency (SDC) is implemented as a retail, account-based central-bank liability S_t with the following properties (these design choices are directly mapped to policy levers in the numerical experiments):

1. **Nature and claims:** SDC is a nominal, account-based liability of the central bank, held by households and redeemable at par. It is modeled as a convenience-bearing outside asset that imperfectly substitutes for bank deposits.
2. **Remuneration:** The central bank can set a nominal remuneration rate i_t^s on SDC holdings. The baseline calibration uses $i^s = 1\%$ with experiments varying i^s. Remuneration is an explicit policy instrument in welfare experiments.

3. **Issuance / redemption:** SDC is issued on demand at par and freely redeemable for central-bank liabilities (no frictions in issuance/redemption in the baseline). Operational constraints and KYC/AML can be modeled via holding caps or tiering (see below).
4. **Tiering / holding limits:** To capture pragmatic policy choices we model a simple tiered remuneration rule: households earn i^s on SDC holdings up to $\underline{S}$; balances above $\underline{S}$ earn $i^s_{low} \leq i^s$. Tiering is used in comparative statics to show how caps mitigate deposit substitution.
5. **Cross-border usability:** Baseline assumes limited cross-border use (a small parameter ψ captures foreign demand). We run sensitivity experiments with larger ψ to show spillovers when the SDC becomes internationally attractive.

Monetary policy rule

We represent the central-bank policy instrument it with a standard partial-adjustment Taylor rule augmented by a financial-stability term and persistence:

$$i_t = \rho_i i_{t-1} + (1 - \rho_i)\big(\phi_\pi \pi_t + \phi_y y_t + \phi_s s_t\big) + \varepsilon^i_t, \qquad (6)$$

where π_t is inflation, y_t the (log) output gap, and s_t a short-run financial-stability indicator (we use the bank spread or the credit gap as stand-ins). Baseline numerical values are $\rho_i = 0.80$, $\phi_\pi = 1.50$, $\phi_y = 0.50$, $\phi_s = 0.25$; we report sensitivity to ϕ_s in Section 5.

The central bank can also set i^s_t (SDC remuneration) independently; welfare experiments treat i^s as an operational parameter. When we report "remuneration near the policy rate" we refer to i^s approaching i in steady state.

Central-bank balance-sheet and recycling

In nominal terms the central bank balance sheet satisfies

$$S_t = A^{cb}_t + R_t, \qquad (7)$$

where S_t denotes outstanding SDC liabilities, A^{cb}_t denotes central-bank assets (government bonds and foreign reserves) and R_t denotes other liabilities (reserves, capital). We introduce a recycling parameter γ in [0,1] that captures the fraction of net SDC inflows the central bank uses to (i) purchase assets or (ii) extend targeted lending that restores bank funding. Operationally, γ = 0 denotes no offset (full disintermediation) while γ = 1 denotes full offset of flows into SDC (no net funding loss to banks).

In the reduced-form arithmetic used in Section 5 the instantaneous effect of a deposit reallocation Δd on loans is

$$\Delta l = \theta(1-\gamma)\Delta d, \tag{8}$$

so that with baseline $\theta = 0.80$ and $\gamma = 0.60$ a 10% deposit reallocation into SDC reduces loans by $0.8 \times (1-0.6) \times 0.10 = 3.2\%$.

Operational remarks and robustness

The above modeling choices are intentionally modular: tiering, cross-border parameter psi, recycling γ, and i_s define the policy space. The intuition and comparative statics map directly to empirical policy levers central banks are considering in practice (see e.g. BIS and central-bank working papers).

External sector

Small open economy: uncovered interest parity (UIP) with risk premium:

$$1 + r_t = (1 + r_t^*)E_t(\frac{e_{t+1}}{e_t}) + \phi_t, \tag{9}$$

where r_t^* is world interest rate, e_t is nominal exchange rate, and ϕ_t is a country-specific premium that depends on capital flows and SDC attractiveness (since SDC can be used cross-border if not geographically restricted).

EQUILIBRIUM AND STEADY STATE CHARACTERIZATION

Define competitive equilibrium given policy paths $\{i_t, i_t^s, recycling\,rule\}$ as allocations and prices solving households', banks', firms' problems and market clearing.

Money substitution and deposit demand

Linearizing the liquidity demand equations gives:

$$s_t - d_t = \alpha_o + \alpha_1(i_t^s - i_t^b) + \alpha_2 z_t, \tag{10}$$

where s_t and d_t are log SDC and deposit holdings, and z_t collects convenience and structural shocks; $a_1 > 0$ implies higher SDC remuneration increases SDC holdings. This relation is central: it captures substitution that triggers bank funding adjustments.

Bank loan supply response

Log-linearizing bank first order conditions and balance sheet constraints yields:

$$l_t = \theta(d_t + o_t) - \kappa(i_t^l - \underline{\pi}_t), \tag{11}$$

where l_t is log loans, κ reflects sensitivity to lending rate and credit risk; importantly,

l_t inherits variations from d_t. A reduction in d_t due to SDC outflows thus reduces lending unless recycled.

Central bank recycling and multiplier on credit

If the central bank recycles SDC liabilities by purchasing government bonds and then financing bank lending (or directly lending), the contractionary effect is dampened. Denote recycling parameter $\gamma \in [0,1]$, the share of SDC inflows the central bank uses to restore bank funding:

$$\Delta l_t = \theta(1-\gamma)\Delta d_t. \quad (12)$$

When γ=1, no net disintermediation occurs; when γ=0, the full deposit outflow reduces banks' lending proportional to θ.

CALIBRATION

This section documents the baseline parameter choices used in the paper, the simple steady-state mapping used for reduced-form intuition, and a compact robustness sweep. The calibration is illustrative for a representative small open economy and is chosen to make model comparative-statics transparent. In Section 5.1, we also provide specific directions for calibrating models of small open economies.

Table 1: Baseline parameters (used throughout this paper unless stated otherwise)

Parameter	Symbol	Baseline
Discount factor	β	0.99
Policy nominal rate (steady)	$\underline{i}$	0.02
SDC remuneration (baseline)	$\underline{i}_s$	0.01
Deposit elasticity	ε_d	6
Intermediate capacity	θ	0.8
Recycling share	γ	0.6
Intertemporal elasticity (inv)	σ	1
Calvo stickiness	—	moderate

Source: Compiled by the authors

β and σ are standard (log utility). $\underline{i}$ and $\underline{i}_s$ are steady nominal benchmarks with the SDC rate set below the policy rate in the baseline. θ captures the "shallowness" of bank intermediation (how many units of loans per unit funding); γ captures the share of SDC inflows the central bank recycles back to banks via asset purchases / lending operations.

Steady-state mapping.

For intuition and quick arithmetic checks we use the reduced-form mapping from deposit reallocation into loans:

$$\Delta l = \theta(1-\gamma)\Delta d. \quad (13)$$

Interpretation: when a fraction of deposits Δd moves from banks into SDC, only the non-recycled share $(1-\gamma)$ reduces bank funding; θ maps funding to loans. Use this relation to sanity-check solver output.

Illustrative numeric example used in the text: for a 10% reallocation away from deposits ($\Delta d = -0.10$), $\theta = 0.80$ and $\gamma = 0.60$ imply

$\Delta l = 0.80 \times (1 - 0.60) \times (-0.10) = -0.032$, i.e., loans fall ≈ 3.2%. (14)

Robustness sweep

Keep the same $\Delta d = -0.10$ and $\theta = 0.80$ while varying γ. Results reported in the paper use the following compact sweep and the accompanying figure:

$\gamma = 0.00 \rightarrow \Delta\ell \approx -8.0\%$ (15)
$\gamma = 0.20 \rightarrow \Delta\ell \approx -6.4\%$ (16)
$\gamma = 0.60 \rightarrow \Delta\ell \approx -3.2\%$ (baseline) (17)
$\gamma = 0.80 \rightarrow \Delta\ell \approx -1.6\%$ (18)

Note: alternative experiments in the appendix vary $\theta \in \{0.6, 0.7\}$ and $\varepsilon_d \in \{3, 10\}$.

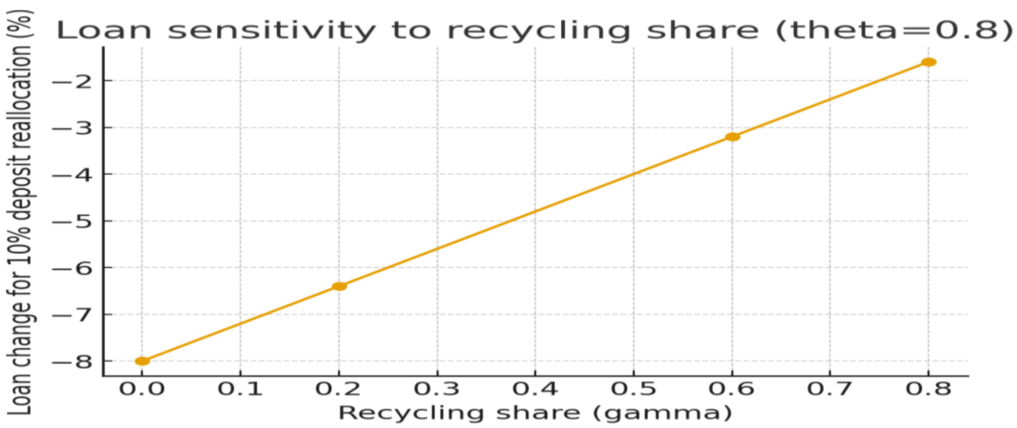

Figure 1: Loan change (%) for a 10% deposit reallocation vs. recycling share γ (baseline $\theta = 0.80$).

Source: Compiled by the authors

Calibration strategy: concise empirical snapshot for small open economies

The list below provides very short, empirical steady-state targets that a reader may use to calibrate the DSGE model for small open economies. Values are taken from central bank/official aggregates and international databases and are reported as calibration targets only; we do not estimate the model in this paper.

- **Azerbaijan.** Policy rate = **7.25%** (World Bank, 2025). Deposit yield = **9.55%** (TheGlobal Economy.com, no date). Loan/ deposit ≈ **73%** (Fitch Ratings, 2025). FDI / net inflows ≈ **0.3% of GDP** (World Bank, no date).
- **Georgia.** Policy rate = **8.0%** (IMF, 2025a). Deposit yields = **10.97%** (TheGlobal Economy.com, no date). Loan/deposit ≈ **109.7%** (IMF, 2025a). FDI / net inflows ≈ **4% of GDP** (World Bank, no date).

Mapping

• Set $\underline{i}$ = observed policy / overnight rate (convert annual → quarterly by $(1 + i_{ann})^{1/4} - 1)$.

• Set pre-SDC deposit remuneration $\underline{i}_d$ = observed average deposit yield; choose $\underline{i}_s$ (SDC remuneration) as scenario values (e.g., 0, below $\underline{i}_d$, or equal to $\underline{i}$).

• Calibrate intermediation capacity θ = sample mean of loans/deposits (use a calm pre-shock window;e.g.,Azerbaijan≈0.73,Georgia≈1.097).

• Map external steady-flow = FDI / net inflows (% GDP) into the model's external-flow steady state (annual % → model frequency).

Reporting requirement (brief): list data source (URL), sample window, conversion formulae (annual → quarter), steady-state shares (loans/GDP, deposits/GDP, reserves/GDP), and a ±20% sensitivity sweep for $\gamma, \theta, \varepsilon_d, i_s$.

Note: the numbers above are empirical calibration targets intended to guide replication or follow-up estimation; the DSGE is not re-estimated here.

ANALYTICAL RESULTS AND COMPARATIVE STATICS

We summarize the main analytic propositions (proof sketches in the Appendix).

Proposition 1 (SDC substitution and deposit rates). If banks have positive deposit market power, introduction of an interest-bearing SDC with $i^s > 0$ forces banks to increase i^b. If deposit demand elasticity is finite, equilibrium deposit rates increase and bank net interest margins compress. (Sketch: banks maximize profits choosing i^b; higher SDC attractiveness reduces deposit demand at given i^b, inducing banks to raise deposit rates to retain deposits.)

Implication. Higher i^b raises households' return on deposits but reduces banks' profitability and may reduce net lending.

Proposition 2 (Disintermediation vs lending). The net effect of SDC introduction on aggregate lending depends on γ (recycling), θ (intermediation capacity), and bank market power. There exists threshold γ^* such that if $\gamma \geq \gamma^*$ SDC introduction does not reduce lending; if $\gamma < \gamma^*$ lending contracts. (Sketch: see equation (10).)

Proposition 3 (Welfare). There exist parameter regions where SDC increases welfare (liquidity gains dominate intermediation loss) and regions where SDC reduces welfare (credit contraction dominates). Borderline conditions depend on deposit substitutability and the monetary policy reaction; optimal SDC remuneration i^s_{opt} can be computed by maximizing the social welfare functional subject to equilibrium constraints. (This mirror results in Burlon et al., 2024.)

Exchange-rate and capital-flow amplification

In the small open economy, SDC adoption can alter capital flows through two channels: (i) an SDC that is attractive to foreign investors generates capital inflows and an appreciation pressure; (ii) SDC-induced domestic deposit outflows to SDC-like offshore instruments (if cross-border) can create volatility. The UIP condition (7) implies exchange-rate responses feed back into net exports and loan collateral valuations, amplifying the initial SDC shock.

Design levers: remuneration and tiering

Analytical comparative statics show:

- **Remuneration i^s:** Low i^s (zero or slightly negative relative to policy) limits deposit outflows but reduces SDC attractiveness; moderate positive i^s can increase welfare by disciplining bank market power (if banks had significant markups), but excessively high i^s causes strong deposit flight and lending contraction.
- **Tiering / caps:** Imposing holding limits or tiered remuneration (higher amounts receive lower or zero interest) bounds displacement of deposits and reduces the probability of large disintermediation episodes.
- **Recycling γ:** A credible recycling commitment is the most effective central-bank instrument to offset credit loss, but it comes with fiscal and operational trade-offs (central bank expansion of balance sheet, potential moral hazard).

WELFARE ANALYSIS AND POLICY RULES

We compute welfare as the expected discounted utility of the representative household, including consumption volatility and credit availability effects (detailed in Appendix B). The social planner internalizes intermediation externalities and chooses i^s, tiering, and maximizing welfare subject to feasibility.

Policy rule (heuristic): For small open economies with shallow banking sectors and moderate external risk premia, the welfare-improvement parameter set typically satisfies:

1. $i^s \in [0, i - \delta]$, where i is the policy rate and $\delta \approx 0.5 - 1$ percentage point (the precise value depends on deposit elasticity). This curbs excessive deposit outflow while retaining some disciplining effect. (Consistent with Garratt & Zhu, 2021.)
2. Implement **tiered holdings** with a zero/remuneration ceiling beyond a modest limit $\underline{S}$ (e.g., fraction of household balances) to prevent wholesale flight.
3. Commit to **recycling** a nontrivial share γ by ex-ante declaring asset-purchase or targeted lending operations to restore bank funding during transition.

These heuristics align with central-bank practice suggestions (BIS, 2021; IMF, 2023; IMF, 2025b) and ensure operational feasibility for small economies with limited deep financial markets.

ROBUSTNESS AND EXTENSIONS

We discuss three robust checks and extensions that preserve main qualitative messages:

1. **Endogenous bank risk-taking.** If banks respond to margin compression by taking more risk, the contractionary lending effect can be partially offset but at the cost of greater systemic risk. This introduces trade-offs between near-term credit availability and long-term stability.
2. **Heterogeneous households.** Allowing heterogeneity in liquidity preferences and cross-border access to SDC refines distributional effects; richer households may substitute more into SDC, altering aggregate outcomes.
3. **Partial adoption and fintech.** Introducing fintech intermediaries that compete with banks and SDC (or provide wrappers around SDC) changes equilibrium margins and can reduce the need for heavy recycling.

All extensions are described in Appendix C and can be implemented within the model's structure.

POLICY DISCUSSION: OPERATIONAL CONSIDERATIONS FOR SMALL OPEN ECONOMIES

Practical takeaways for policymakers:

- **Design conservatively.** Start with a non-or low-interest SDC with modest holding limits and limited cross-border usability until operational and regulatory frameworks mature.

- **Commit to recycling.** Establish transparent rules for how the central bank will use incoming SDC liabilities (asset purchases, targeted lending) to preserve credit flow, and communicate them clearly to avoid destabilizing expectations.
- **Coordinate with fiscal authorities.** Recycling through asset purchases may have fiscal implications—coordination ensures sustainable balance-sheet policies.
- **Monitor market power.** Where banking sectors show concentrated deposit market power, modest SDC remuneration can yield welfare gains by disciplining rates without causing disintermediate.
- **Gradualism and pilots.** Pilot SDC layers (tiering, capped wallets) and monitor bank funding elasticity before scaling up.

CONCLUSION AND FURTHER RESEARCH

This paper develops a compact DSGE framework for a small open economy to analyze the macro-financial consequences of sovereign digital currency (SDC) adoption. The model highlights two central, interacting forces. On one hand, a well-designed SDC improves payments efficiency and can discipline banks' deposit market power, raising household returns and delivering liquidity-service gains. On the other hand, SDC attractiveness can induce deposit substitution, erode banks' funding, and—absent offsetting actions—contract credit and amplify exchange-rate and capital-flow volatility in open economies. The net welfare effect depends critically on SDC design (remuneration, tiering), banking-sector characteristics (intermediation capacity, market power), and the central bank's recycling commitment.

For small open economies with relatively shallow banking sectors, the model's policy message is cautious: modest or tiered remuneration combined with credible recycling and clear operational rules best balance liquidity benefits against the risks to intermediation and financial stability.

The main policy implication is practical: start conservatively (limited remuneration and holding caps), make recycling provisions explicit, and phase expansion through pilots while monitoring bank funding elasticities and cross-border use.

Further research

The model points to a number of promising extensions and empirical exercises that would strengthen understanding of SDCs in small open economies:

1. **Endogenous bank risk and macroprudential interaction.** Model how banks respond to margin pressure by altering risk-taking and how macroprudential tools (countercyclical capital buffers, loan-to-value limits) interact with SDC design choices.

2. **Heterogeneous agents and distributional effects.** Introduce heterogeneity in liquidity needs, financial inclusion, and access to cross-border instruments to assess who benefits or loses from different SDC regimes.
3. **Empirical calibration and structural estimation.** Calibrate the model to country-specific data (deposit elasticities, bank funding mixes, capital-flow sensitivities) to quantify welfare trade-offs and identify country-level optimal designs.
4. **Cross-border SDC spillovers and international coordination.** Endogenize cross-jurisdictional use of SDCs (if allowed) to study contagion, exchange-rate pass-through, and the need for multilateral coordination or capital-flow management.
5. **Fintech intermediaries and private digital money.** Add competing private intermediaries (wallet providers, stablecoins) to evaluate competitive and regulatory responses and to study layered intermediation outcomes.
6. **Political economy and institutional capacity.** Explore how fiscal considerations, central-bank balance-sheet constraints, and institutional credibility shape feasible recycling strategies and long-run adoption paths.

REFERENCES

Andolfatto, D. (2021) 'On the necessity and desirability of a central bank digital currency', in Niepelt, D. (ed.) *Central Bank Digital Currency: Considerations, Projects, Outlook*. CEPR Press.

Auer, R., Boar, C. & Frost, J. (2020) 'CBDC: Beyond Borders', *BIS Bulletin / policy note*.

Bank for International Settlements (BIS) (2021) 'Central bank digital currencies: motives, economic implications and the research frontier', BIS Working Paper No. 976. Available at: https://www.bis.org/publ/work976.pdf

Bank of Canada / Staff (2021) 'Predicting the Demand for Central Bank Digital Currency', Bank of Canada Staff Working Paper 2021-65. Available at: https://www.bankofcanada.ca/2021/12/staff-working-paper-2021-65/

Barrdear, J. & Kumhof, M. (2016) 'The macroeconomics of central bank-issued digital currencies', Bank of England Working Paper (2016).

Burlon, L., Muñoz, M.A. & Smets, F. (2024) 'The optimal quantity of CBDC in a bank-based economy', *American Economic Journal: Macroeconomics*, 16(4), pp. 172–217.

Diamond, D.W. & Dybvig, P.H. (1983) 'Bank Runs, Deposit Insurance, and Liquidity', *Journal of Political Economy*, 91(3), pp. 401–419. Available at: https://www.bu.edu/econ/files/2012/01/DD83jpe.pdf

Drechsler, I., Savov, A. & Schnabl, P. (2017) 'The Deposits Channel of Monetary Policy', *Quarterly Journal of Economics*, 132(4), pp. 1819–1876.

Fernández-Villaverde, J., Sanches, D., Schilling, L. & Uhlig, H. (2021) 'Central bank digital currency: Central banking for all?', *Review of Economic Dynamics*, 41, pp. 225–242.

Fitch Ratings (2025) *Caucasus Banks Benefit Further from Rapid Economic Growth*. Available at:https://www.fitchratings.com/research/banks/caucasus-banks-benefit-further-from-rapid-economic-growth-20-02-2025

Garratt, R. & Zhu, H. (2021) 'On Interest-Bearing Central Bank Digital Currency with Heterogeneous Banks' (working paper). Available at: https://papers.ssrn.com/abstract=3802977

Infante, S., Kim, K., Orlik, A., Silva, A. F. & Tetlow, R. J. (2023) *Retail Central Bank Digital Currencies: Implications for Banking and Financial Stability*, Finance and Economics Discussion Series, No. 2023-072. Washington, D.C.: Board of Governors of the Federal Reserve System. Available at: https://doi.org/10.17016/FEDS.2023.072

International Monetary Fund (IMF) (2023) *Central Bank Digital Currency — Initial Considerations*. Policy Paper, April 2023. Available at: https://www.imf.org/en/Publications/Policy-Papers/Issues/2023/11/14/Central-Bank-Digital-Currency-Initial-Considerations-541466

International Monetary Fund (IMF) (2025a) *Georgia: 2025 Article IV Consultation — Press Release; and Staff Report*. IMF Country Report No. 25/216. Washington, D.C.: International Monetary Fund. Available at: https://doi.org/10.5089/9798229017022.002

International Monetary Fund (IMF) (2025b) *CBDC Virtual Handbook*. Available at: https://www.imf.org/en/Topics/digital-payments-and-finance/central-bank-digital-currency/virtual-handbook

Keister, T. & Sanches, D. (2021) 'Should Central Banks Issue Digital Currency?', Federal Reserve Bank of Philadelphia Working Paper. Available at: https://www.philadelphiafed.org/-/media/frbp/assets/working-papers/2021/wp21-37.pdf

Rahimov, V. & Jafarova, N. (2021) 'The exchange rate pass-through to aggregate consumer price index and its components in Azerbaijan', *The Journal of Economic Sciences: Theory & Practice*, 78(2), pp. 17–42.

Taghiyev, K.R., Yusifov, U.F. & Taghiyev, M.R. (2021) 'Stablecoins and their specific features', *The Journal of Economic Sciences: Theory & Practice*, 78(2).

The Global Economy.com (no date) *Deposit interest rate – country rankings*. Available at: https://www.theglobaleconomy.com/rankings/deposit_interest_rate/ (Accessed: 12 July 2025).

World Bank (2025) *Azerbaijan: Macro Poverty Outlook*. Available at: https://thedocs.worldbank.org/en/doc/d5f32ef28464d01f195827b7e020a3e8-0500022021/related/mpo-aze.pdf (Accessed: 13 July 2025).

World Bank (no date) *Foreign direct investment, net inflows (% of GDP) (BX.KLT.DINV.WD.GD.ZS)*. Available at: https://data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS (Accessed: 13 July 2025).

APPENDICES

(Supplementary mathematical derivations, numerical illustrations and compact extensions)

Appendix A — Full mathematical derivations

A.1 Household problem and first-order conditions

Preferences (log-utility for tractability example):

$$\max_{\{C_t,I_t,D_t,S_t,B_t,L_t\}} E_0 \sum_{t=0}^{\infty} \beta^t \left[lnC_t - \frac{\phi}{2} L_t^2 \right]. \quad \text{(A1)}$$

Period budget constraint (nominal):

$$P_tC_t + Q_tI_t + D_t + S_t = W_tL_t + (1 + i_t^b)D_{t-1} + (1 + i_t^s)S_{t-1} + (1 + r_t)B_{t-1} + \Pi_t - T_t. \quad \text{(A2)}$$

e model transactions services by a liquidity aggregation

$$M_t = \omega_d D_t + \omega_s S_t,$$

with $\omega_d, \omega_s > 0$ (convenience yields). Lagrangian:

$$L = E_0 \sum_{t=0}^{\infty} \beta^t \left[lnC_t - \frac{\phi}{2} L_t^2 + \lambda_t (W_tL_t + (1 + i_t^b)D_{t-1} + (1 + i_t^s)S_{t-1} + (1 + r_t)B_{t-1} + \Pi_t - T_t - P_tC_t - Q_tI_t - D_t - S_t) \right]. \quad \text{(A3)}$$

First-order conditions (selected):

$$Consumption: \frac{1}{C_t} = \lambda_t P_t. \tag{A4}$$

$$Deposits\ (end-of-period): \lambda_t = \beta E_t[\lambda_{t+1}(1+i_{t+1}^b)] + \mu_t \omega_d. \tag{A5}$$

$$SDC\ holdings: \lambda_t = \beta E_t[\lambda_{t+1}(1+i_{t+1}^s)] + \mu_t \omega_s. \tag{A6}$$

$$Foreign\ bonds: \lambda_t Q_t^B = \beta E_t[\lambda_{t+1}(1+r_{t+1})]. \tag{A7}$$

Subtracting (A5) and (A6) and log-linearizing yields the relative demand relation:

$$s_t - d_t = \underline{\alpha}_0 + \underline{\alpha}_1(i_t^s - i_t^b) + \underline{\alpha}_2 z_t, \tag{A8}$$

with $\underline{\alpha}_1 > 0$ (remuneration increases SDC share), and z_t collecting transactions/preference shocks.

A.2 Bank problem and deposit pricing

Banks earn:

$$\Pi_t^b = (1+i_t^l)L_t - (1+i_t^b)D_t - OpCost(D_t, L_t) - Losses_t, \tag{A9}$$

with balance-sheet constraint

$$L_t = \theta(D_t + O_t), \qquad 0 < \theta \le 1, \tag{A10}$$

where O_t denotes other funding.

FOC for deposit-rate choice (using deposit demand derivative D'):

$$-(1+i_t^b)D' - D + \frac{\partial OpCost}{\partial i_t^b} = 0. \tag{A11}$$

Under standard assumptions this implies a markup condition (deposit-rate depends on marginal cost and elasticity), which after log-linearization leads to a loan supply relation of the form:

$$l_t = \theta(d_t + o_t) - \kappa(i_t^l - \underline{\pi}_t). \tag{A12}$$

A.3 Central bank recycling and multiplier

Define recycling share $\gamma \in [0,1]$. For small deposit outflow Δd and substitution $\Delta s \approx -\Delta d$:

$$\Delta l = \theta(1-\gamma)\Delta d. \tag{A13}$$

Thus $\gamma = 1$ fully offsets funding loss; $\gamma = 0$ implies full disintermediation effect.

A.4 Linearization outline and steady state (compact)

Linearized IS (consumption Euler):

$$c_t = E_t c_{t+1} - \sigma(i_t - E_t \pi_{t+1} - r_t^n). \quad \text{(A14)}$$

Linearized Phillips curve:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa_p y_t. \quad \text{(A15)}$$

Steady-state relations (symbolic):

$$1 + i^{-b} = 1 + i^{-l} - spread, \qquad l^{-} = \theta(d^{-} + o^{-}), \quad \text{(A16)}$$

and the static substitution equation:

$$s^{-} - d^{-} = \alpha^{-}{}_0 + \alpha^{-}{}_1(i^{-s} - i^{-b}). \quad \text{(A17)}$$

A.5 Welfare functional and planner FOC

Representative-agent welfare:

$$W = \sum_{t=0}^{\infty} \quad \beta^t E_0 \left[lnC_t - \frac{\phi}{2} L_t^2 \right]. \quad \text{(A18)}$$

Planner's marginal condition (linear approximation):

$$\nu_1 = \nu_2 \theta(1 - \gamma), \quad \text{(A19)}$$

which pins down the interior optimal SDC remuneration i_{opt}^s qualitatively (higher γ allows a higher i_{opt}^s).

Appendix B - Sensitivity snapshot and Welfare Approximation

B.1 Sensitivity snapshot

Holding $\Delta d = -10\%$:

- $\gamma = 0.0$: $\Delta l = 0.8 \times 1 \times (-0.10) = -8.0\%$.
- $\gamma = 0.8$: $\Delta l = 0.8 \times 0.2 \times (-0.10) = -1.6\%$.
- $\theta = 0.6, \gamma = 0.6$: $\Delta l = 0.6 \times 0.4 \times (-0.10) = -2.4\%$.

B.2 Consumption-equivalent welfare approximation (method)

For small welfare perturbations, compute consumption-equivalent λ solving:

$$\sum_{t=0}^{\infty} \beta^t E_0[ln((1+\lambda)C^{-}) - ln(C^{-})] \approx \Delta W,$$

leading to the linear approximation $\lambda \approx \frac{\Delta W}{(1-\beta)C^{-1}}$. Simulate impulse responses under alternative (i^s, γ) and map ΔC_t into ΔW.

Appendix C — Compact extensions and implementation guidance

C.1 Endogenous bank risk-taking

Introduce bank choice over loan risk q_t with expected default rising in loan-to-capital ratio. Loan supply gains a risk-taking term:

$$l_t = \theta(d_t + o_t) - \kappa(i_t^l - \pi^{-}{}_t) + \psi \cdot RT_t, \quad \text{(C1)}$$

where RT_t captures endogenous risk-taking; $\psi > 0$ parametrizes sensitivity.

C.2 Heterogeneous agents

Two household types $i \in \{A, B\}$ with type-specific convenience parameters lead to:

$$s_t^i - d_t^i = \alpha_1^i(i_t^s - i_t^b) + \alpha_2^i z_t^i. \quad \text{(C2)}$$

Aggregate substitution depends on population weights and heterogeneity of α_1^i.

C.3 Cross-border SDC use and coordination

If SDC has cross-border usability parameter $\psi \in [0,1]$, UIP premium ϕ_t in the main text becomes a function of foreign demand for the SDC and capital-flow induced exchange-rate pressures. Coordination is required if ψ is large.

C.4 Operational and institutional constraints

Central-bank balance-sheet constraint (flow form):

$$\Delta A_t^{cb} = \Delta S_t - \Delta R_t - \Delta other\ liabilities, \quad \text{(C3)}$$

and recycling capacity γ may be constrained by fiscal/backstop limits.

Author Contributions: Author Contributions: Conceptualization, N.H., D.A.; methodology, N.H.; software, D.A.; validation, N.H. and D.A.; formal analysis, D.A.; investigation, N.H. and D.A.; resources, D.A.; data curation, N.H. and D.A.; writing - original draft preparation, N.H.; writing—review and editing, N.H.; visualization, D.A.; supervision, N.H. and D.A.; project administration, N.H.; funding acquisition, D.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data is available upon a request.

Conflicts of Interest: The authors declare no conflict of interest.