Stablecoins and Central Bank Digital Currencies: Who Supplies Liquidity?

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Abstract

We develop a tractable monetary framework in which central bank liabilities and privately issued stablecoins provide liquidity services. We study the interaction between managing the *unit of account* and managing the *means of payment* in a currency system. A wedge between market rates and administered remuneration on reserves and tokens makes the supply of public liquidity an independent policy instrument. We characterize when a fully remunerated central bank digital currency or frictionless private issuance can achieve liquidity satiation without losing price-level control, and why balance-sheet risk, seigniorage, and intermediation frictions prevent these knife-edge outcomes. An intermediate regime with a small central bank balance sheet and an elastic backstop stabilizes liquidity premia and inflation.

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1. INTRODUCTION

The birth of Bitcoin marked a turning point for currencies and payment systems.[1] The possibility of creating a private digital currency with decentralized verification spurred not only the development of a broader ecosystem of cryptocurrencies but also the rise of *stablecoins*, which seek to provide alternatives to existing forms of digital and physical payments denominated in traditional currencies. Although these developments were initially met with substantial skepticism in academic and policy circles, central banks and other public institutions quickly recognized the potential challenges and have begun to respond through regulation and, in some cases, through public-sector initiatives. Recent examples include the GENIUS Act in the United States, which establishes a regulatory framework for payment stablecoins,[2] and ongoing efforts toward central bank digital currencies in major jurisdictions such as Europe and China (BIS, 2025).[3]

Stablecoins, in particular, raise questions about the stability of domestic and international monetary systems and have attracted increasing attention from policymakers, academics, and market participants. Some of this debate focuses on familiar issues—run risk, reserve quality, and regulatory design—but one theme has received comparatively less explicit attention: the potential interference or complementarity between managing the *unit of account* of a currency system (such as the dollar or the euro) and managing the *payment system* denominated in that currency.[4]

It is well understood in monetary economics that currency serves as a unit of account, a means of payment, and a store of value. Yet it is not obvious that the institution that manages the unit of account should also be the one that manages the payment system. By *managing the unit of account*, we mean controlling the price level, i.e. the inverse of the value of the currency, which in modern fiduciary monetary systems is a central bank's desirable and feasible objective. By *managing the payment system*, we mean supplying currency-denominated claims that can be used for transaction purposes and, more broadly, for liquidity services, including payments, collateral, and related settlement functions.

The theme is an old one. Monetary systems have long faced a tension between the stability of the unit of account and the payment needs of the economy. Early bimetallic regimes already reflected this trade-off: a system based solely on gold could be too scarce to provide sufficient coin for transactions, while the use of additional metals such as silver expanded the available means of payment at the cost of periodic changes in relative values and, at times, depreciation of the unit of account.

At the peak of the United Kingdom's dominance, the Bank Charter Act of 1844 (Peel's Act) imposed strict discipline on the issuance of banknotes. The Act curtailed the note-issuing privileges of provincial banks and effectively consolidated banknote issuance in the Bank of England for England and Wales. One consequence was that banks increasingly circumvented the constraints on notes by relying on deposits and cheque payments rather than banknotes. An unintended implication was an acceleration of Britain's transition toward a deposit-based payment system, decades ahead of many other countries.[5]

[1] See Nakamoto (2008), the Bitcoin white paper.

[2] See the GENIUS Act; in particular Section 4(a)(11), "Prohibition on interest," which bars payment stablecoin issuers from paying interest or yield to holders (GENIUS Act, 2025).

[3] On the euro area, see ECB reporting on the digital euro project, including the closing report of the preparation phase (ECB, 2025).

[4] For analyses emphasizing peg design and arbitrage mechanisms, see Lyons and Viswanath-Natraj (2023). For historical parallels between stablecoins and private money, and the role of regulation and backing, see Gorton and Zhang (2023).

[5] For a thorough discussion, see Bloomfield (1959) and Eichengreen (1996).

The Bretton Woods system was likewise pervaded by the same tension: the U.S. dollar provided the dominant means of international payments while remaining anchored to a scarce resource—gold. As global liquidity demand expanded, the volume of dollar liabilities outpaced the available gold backing, contributing to the eventual collapse of the system (Triffin, 1960; Eichengreen, 1996).

This historical evidence is striking. In each of the three episodes above, the tension between the stability of the unit of account and the payment needs of the economy arose in monetary systems ultimately anchored to scarce metals. By contrast, modern monetary systems are based on fiduciary currencies that are not convertible into commodity reserves and have no intrinsic backing value. In principle, relaxing the commodity constraint should expand the scope for providing payment instruments and liquidity services denominated in the unit of account: when the unit of account is no longer tied to a scarce physical resource, the supply of transaction media can be scaled elastically to meet the economy's demand. Yet the modern era has not eliminated the underlying trade-off. Instead, it has shifted it to new margins—the design of monetary liabilities, the institutions that issue them, and the balance-sheet and regulatory constraints that govern their supply.

The recent growth of stablecoins and the renewed interest in central bank digital currencies bring this tension to the forefront. Stablecoins seek to provide privately issued, currency-denominated payment instruments at scale, while CBDCs extend central bank liabilities directly into retail or wholesale payment systems. These developments raise a basic question: how does the provision of liquidity services through currency-denominated claims interact with the control of the unit of account, i.e. the determination of the price level?

In this paper, we develop a stylized monetary framework to study the joint determination of (i) liquidity provision in the payment system and (ii) the unit-of-account objective of price-level stability. The model highlights a distinction between the *market* nominal interest rate that prices intertemporal substitution and the *administered* remuneration rates on central bank liabilities, a distinction that is central in modern operating frameworks with interest on reserves.[6] This distinction implies that monetary policy may operate not only through administered rates but also through the quantities of central bank liabilities, because the supply of liquidity affects equilibrium liquidity premia. Building on this foundation, we use the model to compare regimes in which liquidity is provided predominantly by the central bank (through reserves and potentially tokens), by the private sector (through stablecoins or private money), or by the Treasury (through liquid government debt or fiscal backing). The goal is to clarify when these arrangements are complements or substitutes, and how they reshape the constraints and instruments of monetary policy.

In the benchmark CBDC framework, the central bank controls both the remuneration rate and the quantity of reserves, while the quantity of central bank tokens held by the private sector is determined endogenously. In this environment, there exists an equilibrium in which liquidity demand is fully satisfied and the central bank retains control of the price level. Achieving full satiation requires the central bank to set the token remuneration rate equal to the reserve remuneration rate and to supply an abundant quantity of reserves.

This outcome, however, is not costless. A key implication of the model is an economy-wide resource requirement: supplying enough liquidity to satiate the economy requires a sufficiently large stock of asset holdings on the central bank balance sheet, and those assets must remain of sufficiently high quality so that default risk and valuation losses do not undermine the nominal anchor. This balance-sheet discipline can

[6] Early discussions include Goodfriend (2002).

be relaxed if the central bank is allowed to receive fiscal support—for instance, via recapitalizations from the Treasury (Del Negro and Sims, 2015; Hall and Reis, 2015). In the extreme case in which the boundary between monetary and fiscal authorities is weak and Treasury liabilities are effectively guaranteed, fiscal policy becomes central for price-level determination (Leeper, 1991; Cochrane, 2023): the Treasury's fiscal capacity influences the price level (and, together with administered rates, its dynamics), and full liquidity satiation requires sufficiently strong fiscal backing.

These results connect naturally to Friedman's discussion of liquidity supply. Friedman (1960) emphasized that the provision of safe liquidity is ultimately a government responsibility and discussed two complementary ways of supporting that responsibility: backing through high quality assets held by the monetary authority and backing through the government's taxing power. Our framework provides a simple environment in which these two channels map directly into the feasibility and desirability of liquidity satiation, and into the respective roles of the central bank and the Treasury in anchoring the price level.

The second interesting result is that the same allocation can, in principle, be replicated by a frictionless competitive market in which intermediaries supply deposit-like private money that competes with reserves, and stablecoin issuers supply token-like claims that compete with central bank tokens. In the knife-edge case of perfect competition and no intermediation frictions, competition drives remuneration in the liquidity markets to the level of the money-market return, so that the economy can attain full liquidity satiation. Equivalently, full liquidity provision requires sufficient backing: the liabilities issued by intermediaries and stablecoin issuers must be supported by assets held on their balance sheets. In a richer environment with risky assets, that backing can combine safe assets with loss-absorbing capital (equity or subordinated claims) that protects the promised value of money-like liabilities against valuation losses. Importantly, in this benchmark the central bank need not operate a large balance sheet: price-level control can be preserved with standard instruments—maintaining a positive supply of reserves and setting the administered reserve rate—while the private sector provides the bulk of liquidity services.

There is, however, an important institutional difference between implementation through the central bank and implementation through private issuers. Central bank liabilities have a natural advantage in safety: reserves and central bank tokens are settlement assets and are default-free in the unit of account. They define the currency as a claim on itself. By contrast, private sector liabilities are not "true" currency but "synthetic" currency: they are promises to deliver the currency and therefore inherit the balance-sheet, governance, and operational risks of the issuer.

These knife-edge first-best outcomes do not map naturally into the monetary regimes that authorities are currently shaping. Recent regulatory initiatives explicitly limit the ability of private and public digital tokens to pay interest. The GENIUS Act in the United States prohibits payment stablecoin issuers from paying interest or yield to holders.[7] Likewise, current design proposals for the digital euro emphasize that retail holdings would not be remunerated and would be subject to quantitative limits (ECB, 2025).[8] These design choices imply that full satiation of token liquidity cannot be achieved in general unless the relevant market nominal rate is close to zero.

More broadly, even abstracting from explicit restrictions on token remuneration, it is not obvious that the

[7] See the GENIUS Act text (Section 4(a)(11), "Prohibition on interest") (GENIUS Act, 2025).

[8] For background and design discussion, see ECB (2023) on the investigation phase and ECB (2025) on the preparation phase closing report.

central bank would want—or be able—to implement the first-best allocation characterized by full liquidity satiation.

On the feasibility side, full satiation requires a very large stock of central bank liabilities. In our framework, this implies that the central bank must hold a sufficiently large stock of backing assets, and that the quality and risk profile of those assets must not jeopardize the nominal anchor. If backing assets are not perfectly safe, large balance-sheet expansions can expose the central bank to valuation losses and increase the likelihood that remittances or recapitalization constraints become relevant (Bassetto and Messer, 2013; Del Negro and Sims, 2015; Hall and Reis, 2015; Benigno and Nisticò, 2020). Even when fiscal support is available in principle, relying on it may raise concerns about fiscal interdependence and the perceived independence of monetary policy.

There are also fiscal and political-economy considerations tied to the central bank's monopoly over currency issuance. Central bank liabilities typically generate seigniorage-like revenues: issuing money-like claims at a low administered return and investing in interest-bearing assets creates an interest margin that can be rebated to the Treasury through remittances. In a regime with full satiation and full remuneration parity, those margins shrink or vanish, and the fiscal value of the currency franchise is reduced. Conversely, maintaining non-remunerated or low-remunerated instruments (as with cash, or with non-remunerated retail CBDC designs) preserves a seigniorage component, but it does so by keeping the economy away from the satiated region and by sustaining liquidity premia (Friedman, 1969). This trade-off can make token remuneration and the scale of CBDC issuance inherently contentious: they affect not only monetary transmission but also the allocation of rents associated with the currency monopoly.

Finally, in the current monetary framework—in which banks play the dual role of providing liquidity and extending credit to the economy—a fully remunerated and freely scalable CBDC could induce large shifts of funding away from banks and other private intermediaries toward central bank liabilities. This reallocation could tighten the supply of private credit and amplify stress in bank funding markets (Keister and Sanches, 2023; Andolfatto, 2021). In an idealized framework that separates the provision of money-like liquidity from credit intermediation, this particular risk would be attenuated or may not arise.

A natural question is whether the private sector could instead deliver the first best through frictionless competition. The model makes clear that this is also an extreme benchmark. In practice, intermediation is costly and subject to frictions: redemption, settlement, and compliance costs; monitoring and auditing costs; liquidity management and liquidation costs; and the possibility that reserve assets are not perfectly safe or not perfectly liquid. These forces correspond to time-varying wedges δ^e_{t+1} and δ^a_{t+1} in the stablecoin and private-money sectors, respectively. Once these wedges are positive, competitive issuers cannot deliver the full money-market return to holders of money-like liabilities, and the economy generally operates below full satiation. Moreover, when intermediation efficiency is state dependent—for example, when liquidation constraints bind or when risk premia rise in stress states—the effective remuneration on private money and stablecoins becomes endogenous and potentially unstable, increasing the scope for de-pegging, quantity contractions, and run-like dynamics (Diamond and Dybvig, 1983; Gorton and Pennacchi, 1990; Lyons and Viswanath-Natraj, 2023). In that sense, even if private issuance can efficiently provide liquidity in normal times, it cannot be expected to implement the first-best allocation robustly across states of the world.

With the background of the discussion above, which makes it unlikely that the first-best can be implemented robustly either by the government or by the private sector, an intermediate regime becomes both relevant and feasible.

In this regime, the central bank maintains a relatively small balance sheet, as in the pre–Global Financial Crisis operating framework, holds primarily short-term safe securities, and implements policy through the administered interest rate on reserves while supplying a positive quantity of reserves to the system. Private issuers provide a significant share of token-like and money-like claims in normal times, but stablecoin issuance and private money creation are subject to frictions and risk. By setting the interest rate on reserves, the central bank can in principle insulate the path of the price level and inflation from disturbances originating in the token (stablecoin) market. Regulation can complement this arrangement through reserve-asset and governance requirements that reduce redemption and intermediation frictions, without necessarily prohibiting remuneration altogether, thereby allowing the economy to attain as much token-liquidity provision as is feasible.

The central bank may also choose to issue its own tokens, but in this intermediate regime such issuance is best viewed as quantitatively limited in normal times and primarily as a backstop instrument. When disruptions in token markets sharply reduce effective token liquidity, the central bank can expand the supply of public liquidity and/or adjust administered rates to prevent an inefficient liquidity contraction.

At the same time, operating with a small supply of reserves does not eliminate all sources of vulnerability. Price-level control can still be affected by disturbances in reserve-like private claims that compete with reserves in providing liquidity services. Regulation of the intermediary sector can reduce the likelihood and severity of such disturbances, but it cannot rule them out entirely. In this environment, liquidity premia and quantities become state dependent: adverse shocks that raise δ^e_{t+1}—the wedge in the reserve-like private market—reduce effective liquidity services and, at the same time, affect the price level and economic activity. Such shocks trigger substitution toward safer public liabilities and may require the central bank to adjust administered rates and/or the quantity of reserves to stabilize the market interest rate and the inflation path. Precisely for this reason, maintaining a relatively small central bank balance sheet in normal times may facilitate more active and flexible reserve management in episodes in which private liquidity provision contracts or becomes more turbulent.

This paper is organized as follows. The next subsection reviews the related literature. Section 2 develops the main framework and characterizes equilibrium. Section 3 analyzes the implications for price-level determination and liquidity in a central bank digital currency framework. Section 4 extends the analysis to privately issued securities, while Section 5 studies the implication of the treasury providing liquidity and backing the price level. Finally, Section 6 concludes.

1.1. Related literature

A useful starting point for situating this paper is the classic debate on whether the monetary system should be organized around government monopoly or competition in the provision of money and near-money instruments. Hayek (Hayek, 1976) advocates denationalizing money and allowing competing private currencies, while Friedman (Friedman, 1960) and Friedman and Schwartz (Friedman and Schwartz, 1986) remain skeptical that purely fiduciary private monies would successfully displace an entrenched government currency absent crisis conditions. In particular, Friedman and Schwartz (Friedman and Schwartz, 1986) emphasize historical forces pushing toward a single unit of account and persistent government involvement, and relate the feasibility of competitive arrangements to contract enforcement, fraud, and the lender-of-last-resort problem (Bagehot, 1873; Smith, 1936). Related contributions in the same tradition question the natural-monopoly rationale for government currency (Klein, 1974, 1976; Vaubel, 1984) and study historical free-banking episodes and the organization of competitive payment systems. A point especially close to the concerns of this paper is that competitive arrangements can innovate on the payments side even when the unit of account remains centralized; see, for instance, (White, 1984a,b). A related perspective is offered by Sargent (2011), who frames monetary and financial design as a recurring problem of where to draw institutional lines between money, banking, and regulation, emphasizing the stability–efficiency trade-offs that arise when money-like claims are privately created and publicly backstopped.

Our paper brings these questions to the digital era: stablecoins and private money map naturally into inside-money provision, while central bank digital currency expands the menu of government liabilities. Our framework formalizes when private liquidity provision can coexist with (or challenge) unit-of-account stability by distinguishing the market nominal rate from administered remuneration rates on central bank liabilities and by making explicit the balance-sheet and backing constraints that tie liquidity provision to the nominal anchor.

The banking and monetary literature is also rich with models of private liquidity creation in the spirit of the seminal contribution of Gorton and Pennacchi (1990), and the broader tradition that studies how intermediaries produce money-like claims and how this interacts with fragility, runs, and the conduct of policy (Diamond and Dybvig, 1983; Gorton, 2010; Holmström, 2015).[9] These ideas are reflected in our reduced-form wedges capturing intermediation costs, risk, and redemption frictions in private money and stablecoin issuance, and in our emphasis on how shifts in liquidity premia propagate to equilibrium nominal interest rates.

A closely related strand analyzes the boundary between public and private money and provides equivalence and neutrality results for policy swaps across monetary architectures (Brunnermeier and Niepelt, 2019). Close to the approach taken here are also papers that emphasize the role of safe assets and the interaction between central bank balance-sheet policy, prudential regulation, and private liquidity creation. Magill, Quinzii, and Rochet (2020) analyze optimal combinations of monetary, prudential, and balance-sheet policies in an environment with high demand for safe assets, rationalizing large-scale asset purchases and interest on reserves. Benigno and Robatto (2019) study private money creation and government interventions in the presence of liquidity crises. Relative to these contributions, our focus is distinct: we study how administered rates on central bank liabilities and the quantity of reserves jointly determine equilibrium liquidity premia and, through the market interest rate, inflation dynamics. We also extend the comparison of monetary architectures to competition from stablecoins and token-like claims, as well as to regimes in which asset backing or fiscal backing become central for the nominal anchor.[10]

A central theme of this paper is the disconnect between the *market* interest rate that prices intertemporal substitution and the *administered* rates set on central bank liabilities (notably interest on reserves), a wedge that naturally arises when reserves and closely related instruments deliver convenience or liquidity services. This

[9] A related macro-finance strand documents that even default-free government liabilities can command sizable "convenience yields" or liquidity premia (Krishnamurthy and Vissing-Jorgensen, 2012; Nagel, 2016), and connects these premia to the supply and maturity structure of safe assets (Greenwood, Hanson, and Stein, 2015; Caballero, Farhi, and Gourinchas, 2017).

[10] On the link between nominal anchors, central bank balance sheets, and fiscal backing, see Leeper (1991), Woodford (1995), Cochrane (2023), Del Negro and Sims (2015), Hall and Reis (2015), and Benigno (2020).

theme connects to work on operating frameworks and administered rates (Goodfriend, 2002; Bindseil, 2014), and to the empirical literature estimating reserve demand and the convenience yield of government liquidity.[11] It also connects to New Keynesian and macro-banking models that depart from the standard single-instrument paradigm by allowing the central bank to operate with multiple instruments—an administered reserve rate and the quantity of reserves—and by studying implications for determinacy, spreads, and transmission (Benigno and Nisticò, 2017; Benigno and Benigno, 2021; Diba and Loisel, 2021; Piazzesi, Rogers, and Schneider, 2021). Relative to this literature, our contribution is to place price-level determination and the nominal anchor at center stage: we show how administered rates and quantities jointly shape equilibrium liquidity premia and therefore the market rate entering the Fisher relation, and we extend the analysis to competition from stablecoins and private money.

A growing macro–finance literature studies cryptoassets and stablecoins as new forms of money-like claims and asks when they can function as media of exchange without undermining monetary and financial stability. Schilling and Uhlig (2019) provide a simple equilibrium framework for Bitcoin that clarifies how scarcity, beliefs, and transaction demand can support a positive price for a non-sovereign digital asset. Benigno, Schilling, and Uhlig (2022) study cryptocurrency-based currency competition in open economies and show how widespread use of a global cryptoasset tightens the classic "impossible trinity" by disciplining independent monetary policy through interest-parity restrictions. A related line of work studies public digital money and banking: Fernández-Villaverde et al. (2021) and Schilling, Fernández-Villaverde, and Uhlig (2024) emphasize that widely accessible central bank liabilities can reshape bank funding and generate a tension between price stability and financial stability. Relative to Schilling, Fernández-Villaverde, and Uhlig (2024), who highlight a run-based "trilemma" between efficiency, price stability, and financial stability when the central bank becomes a dominant intermediary, our framework isolates a complementary channel: administered remuneration and balance-sheet quantities shape liquidity premia and thereby the market rate that anchors inflation, even absent run dynamics. More generally, our paper is complementary to this literature by focusing on the unit-of-account dimension: we treat stablecoins and private money as liquidity-producing claims subject to intermediation wedges, and we show how the joint choice of administered remuneration on central bank liabilities and the supply and backing of those liabilities determines equilibrium liquidity premia and the market rate that anchors inflation.

Finally, this paper relates to the growing literature on CBDC and monetary architecture, which studies CBDC as a change in the menu of government liabilities and in the organization of intermediation (Barrdear and Kumhof, 2022; Kumhof and Noone, 2021; Andolfatto, 2021; Keister and Sanches, 2023; Niepelt, 2024, 2025). We are complementary to this work in that we focus on the interaction between liquidity provision and the nominal anchor in a framework that cleanly separates administered rates from the market rate, and we extend the comparison to stablecoins.[12]

Our analysis is also related to the literature on price-level determination and nominal anchoring. It combines the central bank theory of the price level of Benigno (Benigno, 2020, 2025a) with the fiscal theory of the price level (Leeper, 1991; Sims, 1994; Woodford, 1995; Cochrane, 2023). Related contributions study how central bank balance-sheet constraints, remittances, and recapitalization policies interact with the nominal anchor (Bassetto and Messer, 2013; Del Negro and Sims, 2015; Hall and Reis, 2015; Benigno and Nisticò, 2020).

[11] See, among others, Krishnamurthy, Nagel, and Vissing-Jorgensen (2018) and Lopez-Salido and Vissing-Jorgensen (2023).

[12] On stablecoin design, de-pegging risk, and the role of redemption frictions and reserve quality, see Lyons and Viswanath-Natraj (2023) and Gorton and Zhang (2023). Policy discussions include BIS (2022) and FSB (2023), among others.

Our framework complements these approaches by highlighting how administered rates and the *quantity* of reserves jointly shape equilibrium liquidity premia and thereby the market rate entering the Fisher relation, while clarifying when disruptions in token-like markets can remain orthogonal to price determination under a well-defined nominal anchor.

An important extension of these issues is international. Recent work emphasizes that stablecoins denominated in a reserve currency can operate through a global safe-asset and liquidity channel, potentially transmitting shifts in dollar liquidity demand across borders (Ferrari Minesso and Siena, 2026) and thereby reshaping the domestic transmission of monetary policy.[13]

2. MODEL

2.1. Consumers

We consider a representative household in a closed endowment economy. The household derives utility from consumption and from the liquidity services provided by central bank liabilities. Lifetime utility is

$$\sum_{t=t_0}^{\infty} \beta^{t-t_0} \left\{ U(C_t) + \xi_{q,t} V(q_t) + \xi_{h,t} L(h_t) \right\}, \tag{1}$$

where $\beta \in (0,1)$ is the subjective discount factor and C_t denotes consumption of the final good. The functions $U(\cdot)$, $V(\cdot)$, and $L(\cdot)$ are increasing, concave, and continuously differentiable.

Liquidity services arise from two forms of central bank liabilities. Real balances of (interest-bearing) central bank deposits and tokens are

$$q_t \equiv \frac{X_t}{P_t}, \qquad h_t \equiv \frac{M_t}{P_t},$$

where P_t is the price of the consumption good, X_t denotes central bank deposits ("reserves"), and M_t denotes central bank tokens. The shifters $\xi_{q,t}$ and $\xi_{h,t}$ capture exogenous variation in the demand for liquidity services from reserves and tokens, respectively.[14]

Both $V(\cdot)$ and $L(\cdot)$ exhibit satiation: there exist $\bar{q} > 0$ and $\bar{h} > 0$ such that $V_q(q) = 0$ for all $q \geq \bar{q}$ and $L_h(h) = 0$ for all $h \geq \bar{h}$, where $V_q(\cdot)$ and $L_h(\cdot)$ denote derivatives with respect to their arguments.[15]

The household faces the nominal budget constraint

$$B_t + X_t + M_t - D_t + P_t C_t + T_t = (1 + i_{t-1})(B_{t-1} - D_{t-1}) + (1 + i^x_{t-1}) X_{t-1} + (1 + i^m_{t-1}) M_{t-1} + P_t Y, \tag{2}$$

where Y is a constant real endowment and T_t denotes lump-sum taxes (nominal). The household can allocate wealth across four one-period nominal instruments: Treasury bonds B_t, private debt D_t, central bank deposits X_t remunerated at the policy rate i^x_t, and central bank tokens M_t remunerated at i^m_t. Treasury bonds and private debt earn the market nominal rate i_t and, by assumption, provide no liquidity services.

[13] Related open-economy analyses of digital currencies study how monetary policy and exchange-rate dynamics adjust when currency-like digital instruments circulate internationally (Cova et al., 2022).

[14] If $\{\xi_{q,t}, \xi_{h,t}\}$ are stochastic processes, expectations can be added to (1) and to the Euler conditions below. For simplicity purposes, we focus on a perfect foresight analysis.

[15] We allow V_{qq} and L_{hh} to be discontinuous at the satiation points.

The sign convention in (2) interprets D_t as one-period nominal borrowing: the household issues private debt and repays it at the market rate i_t. Unless stated otherwise, we restrict $X_t \geq 0$ and $M_t \geq 0$, and impose a standard no-Ponzi condition (or an equivalent borrowing limit) on the household's net market-rate position.

In this section, we deliberately restrict liquidity services to central bank liabilities (X_t and M_t) in order to isolate the role of CBDC remuneration policy. While safe government debt can be highly liquid in practice, abstracting from its liquidity role here keeps the analysis transparent. In a later section, we relax this assumption by allowing additional securities (private or Treasury) to provide liquidity services.

Given the flow budget constraint (2) and a standard no-Ponzi condition, the household's feasible allocations can be equivalently characterized by the intertemporal budget constraint

$$\sum_{t=t_0}^{\infty} R_{t_0,t}\left(C_t + u_t^x q_t + u_t^m h_t\right) \leq \frac{\mathcal{W}_{t_0-1}}{P_{t_0}} + \sum_{t=t_0}^{\infty} R_{t_0,t}\left(Y - \frac{T_t}{P_t}\right), \tag{3}$$

where, for any $s \leq t$, the real discount factor is

$$R_{s,t} \equiv \frac{P_t}{P_s}\prod_{k=s}^{t-1}\frac{1}{1+i_k}, \qquad R_{t,t} = 1,$$

and it is convenient to define the *user costs* of reserves and tokens,

$$u_t^x \equiv \frac{i_t - i_t^x}{1+i_t}, \qquad u_t^m \equiv \frac{i_t - i_t^m}{1+i_t}, \tag{4}$$

as well as the initial nominal wealth term

$$\mathcal{W}_{t_0-1} \equiv (1+i_{t_0-1})(B_{t_0-1} - D_{t_0-1}) + (1+i_{t_0-1}^x)X_{t_0-1} + (1+i_{t_0-1}^m)M_{t_0-1}. \tag{5}$$

Relative to the standard endowment economy, the additional terms $u_t^x q_t$ and $u_t^m h_t$ capture the opportunity cost of holding liquid central bank liabilities when they yield a lower return than market-rate debt. When $i_t^x < i_t$, holding reserves entails a positive user cost; when $i_t^m < i_t$, holding tokens entails a positive user cost.

To characterize optimality, let λ_t denote the multiplier on (2). The first-order condition for consumption implies $\lambda_t = U_c(C_t)/P_t$. The Euler equation for market-rate debt is

$$\frac{U_c(C_t)}{P_t} = \beta(1+i_t)\frac{U_c(C_{t+1})}{P_{t+1}}. \tag{6}$$

The first-order condition for reserves (when $X_t > 0$) is

$$\frac{U_c(C_t)}{P_t} = \frac{\xi_{q,t}}{P_t} V_q(q_t) + \beta(1+i_t^x)\frac{U_c(C_{t+1})}{P_{t+1}}, \tag{7}$$

which, using (6), can be expressed as

$$1 = \underbrace{\frac{\xi_{q,t} V_q(q_t)}{U_c(C_t)}}_{\text{liquidity premium from reserves}} + \frac{1+i_t^x}{1+i_t}. \tag{8}$$

Equation (8) states that, at the margin, the household is indifferent between investing one additional unit of currency in a market-rate bond and holding it as reserves: the lower pecuniary return on reserves (if $i_t^x < i_t$) is compensated by their marginal liquidity services.

Similarly, the first-order condition for tokens (when $M_t > 0$) is

$$\frac{U_c(C_t)}{P_t} = \frac{\xi_{h,t}}{P_t} L_h(h_t) + \beta(1+i_t^m)\frac{U_c(C_{t+1})}{P_{t+1}}, \tag{9}$$

which implies

$$1 = \underbrace{\frac{\xi_{h,t} L_h(h_t)}{U_c(C_t)}}_{\text{liquidity premium from tokens}} + \frac{1+i_t^m}{1+i_t}. \tag{10}$$

When liquidity is satiated for a given instrument (e.g., $V_q(q_t) = 0$), the associated liquidity premium is zero and its remuneration rate equals the market rate.

The intertemporal constraint (3) holds with equality at the optimum:

$$\sum_{t=t_0}^{\infty} R_{t_0,t}\left(C_t + u_t^x q_t + u_t^m h_t\right) = \frac{\mathcal{W}_{t_0-1}}{P_{t_0}} + \sum_{t=t_0}^{\infty} R_{t_0,t}\left(Y - \frac{T_t}{P_t}\right). \tag{11}$$

2.2. Government

The government comprises a Treasury and a central bank. The Treasury issues one-period nominal debt and levies lump-sum taxes. The central bank holds a portfolio of one-period nominal assets and issues two types of one-period liabilities to the household: reserves and tokens, remunerated at rates i_t^x and i_t^m, respectively. Throughout, Treasury debt and private debt pay the market nominal interest rate i_t.

The central bank's flow budget constraint is

$$D_t^C + B_t^C - X_t^C - M_t^C = (1+i_{t-1})(B_{t-1}^C + D_{t-1}^C) - (1+i_{t-1}^x)X_{t-1}^C - (1+i_{t-1}^m)M_{t-1}^C - T_t^C, \tag{12}$$

where B_t^C denotes the central bank's holdings of one-period Treasury debt, D_t^C denotes its holdings of one-period private debt, and X_t^C and M_t^C denote the outstanding quantities of reserves and tokens (central bank liabilities). The term T_t^C denotes nominal remittances from the central bank to the Treasury. Below we impose $T_t^C \geq 0$, which rules out fiscal support of the central bank (i.e., transfers from the Treasury to the central bank).

The Treasury's flow budget constraint is

$$B_t^F = (1+i_{t-1})B_{t-1}^F - T_t - T_t^C, \tag{13}$$

where B_t^F denotes the Treasury's outstanding one-period nominal debt and T_t denotes lump-sum taxes. We impose a standard solvency condition under which Treasury liabilities are default free:

$$\frac{(1+i_{t_0-1})B_{t_0-1}^F}{P_{t_0}} = \sum_{t=t_0}^{\infty} R_{t_0,t}\left(\frac{T_t}{P_t} + \frac{T_t^C}{P_t}\right). \tag{14}$$

We write (14) with equality, thereby ruling out histories in which the Treasury raises taxes in excess of what is required to service its liabilities. Treasury debt pays the market nominal interest rate i_t because, by assumption, it does not provide liquidity services.

2.3. Equilibrium

Equilibrium in asset markets requires that Treasury debt be held by the representative household and the central bank:

$$B_t^F = B_t^C + B_t. \tag{15}$$

Central bank liabilities are held by the household:

$$X_t^C = X_t, \qquad M_t^C = M_t, \tag{16}$$

for each $t \geq t_0$. Private debt is held by the central bank:

$$D_t^C = D_t. \tag{17}$$

Whenever it is not ambiguous, we use market clearing (e.g., $D_t^C = D_t$) to simplify notation.

Since the economy is an endowment economy with no government purchases, goods market clearing implies

$$C_t = Y, \qquad \forall t \geq t_0. \tag{18}$$

Using $C_t = Y$ in the household Euler equation (6) yields

$$1 + i_t = \frac{1}{\beta}\frac{P_{t+1}}{P_t}, \tag{19}$$

for each $t \geq t_0$. Thus, it is the market nominal interest rate i_t that is directly linked to inflation via (19).

The reserve market, using (8) and $C_t = Y$, implies

$$\frac{1+i_t^x}{1+i_t} = 1 - \xi_{q,t} V_q\left(\frac{X_t}{P_t}\right), \tag{20}$$

for each $t \geq t_0$, where we normalize units so that $U_c(Y) = 1$. Similarly, equilibrium in the token market implies

$$\frac{1+i_t^m}{1+i_t} = 1 - \xi_{h,t} L_h\left(\frac{M_t}{P_t}\right). \tag{21}$$

Because $V_q(\cdot) \geq 0$ and $L_h(\cdot) \geq 0$, these conditions imply $i_t^x \leq i_t$ and $i_t^m \leq i_t$ whenever reserves and tokens are not satiated; the wedges vanish when the relevant instrument is satiated.

Using $C_t = Y$ in the household intertemporal budget constraint (11) and cancelling the present value of the endowment yields

$$\sum_{t=t_0}^{\infty} R_{t_0,t}\left(\frac{T_t}{P_t} + u_t^x q_t + u_t^m h_t\right) = \frac{\mathcal{W}_{t_0-1}}{P_{t_0}}. \tag{22}$$

Under the Fisher equation (19), $R_{t_0,t} = \beta^{t-t_0}$ in equilibrium, so (22) can equivalently be written with discounting by β^{t-t_0}.

Using Treasury solvency (14) and the market-clearing conditions, one can express the intertemporal resource constraint as

$$\sum_{t=t_0}^{\infty} \beta^{t-t_0}\left(\frac{T_t^C}{P_t}\right) = \frac{\mathcal{W}_{t_0-1}^C}{P_{t_0}} + \sum_{t=t_0}^{\infty} \beta^{t-t_0}\left(u_t^x q_t + u_t^m h_t\right), \tag{23}$$

which states that the present discounted value of remittances equals the initial real net worth of the central bank plus the present discounted value of the interest differentials (user costs) generated by issuing reserves and tokens.[16] Note that

$$\mathcal{W}_{t_0-1}^C \equiv (1 + i_{t_0-1})(B_{t_0-1}^C + D_{t_0-1}) - (1 + i_{t_0-1}^x)X_{t_0-1} - (1 + i_{t_0-1}^m)M_{t_0-1}.$$

An equilibrium is a collection of sequences

$$\left\{P_t,\, i_t,\, i_t^x,\, i_t^m, B_t^C,\, D_t,\, X_t,\, M_t, T_t^C\right\}_{t=t_0}^{\infty}$$

(with $P_t > 0$ and $X_t > 0$, $M_t, B_t^C, D_t, T_t^C \geq 0$) such that the following equations are satisfied for each $t \geq t_0$: (12), (19), (20), and (21) given the exogenous sequences $\left\{\xi_{q,t}, \xi_{h,t}\right\}_{t=t_0}^{\infty}$. Moreover (23) holds in equilibrium given initial condition $\mathcal{W}_{t_0-1}^C$.[17] The equilibrium restrictions leave five degrees of freedom to specify monetary policy. Central bank policy can be specified through the remuneration rates (i_t^x, i_t^m) on the liabilities, three out of the five balance-sheet components $(X_t, M_t, B_t^C, D_t, T_t^C)$.

There are several important features of the equilibrium.

First, fiscal policy does not play an independent role in the determination of the price level in this environment. In equilibrium, the price level is pinned down by monetary policy—specifically, by the pricing relations implied by household optimality and by the remuneration of central bank liabilities. This feature is consistent with the "central bank theory of the price level" as discussed in (Benigno, 2020, 2025a). The Treasury issues nominal debt and levies lump-sum taxes, but these fiscal instruments affect equilibrium only through the government intertemporal budget constraints that guarantee the solvency of Treasury liabilities. In particular, equilibrium pricing does not require an active fiscal rule in the sense of the fiscal theory of the price level. The central bank may hold Treasury bonds B_t^C, but it is not necessary for B_t^C to be positive; the analysis accommodates the case in which the central bank does not hold Treasury debt at any date.

Second, the set of policy instruments available to the central bank is particularly rich. The central bank can set the remuneration rates on its liabilities, (i_t^x, i_t^m), and it can also choose the quantities of each liability

[16]The constraint (23) is an intertemporal resource constraint and not a solvency constraint, see Benigno (2025a).

[17]It should be clear that all the subcomponents of the initial condition $\mathcal{W}_{t_0-1}^C$ should be independently specified.

outstanding, (X_t^C, M_t^C).[18] In addition, it can determine the composition of its asset portfolio—for instance, the split between holdings of Treasury debt B_t^C and private debt D_t^C—subject to its balance-sheet constraint. These multiple instruments generally allow the central bank to implement a variety of equilibrium allocations and wedges between the market rate i_t and the administered rates (i_t^x, i_t^m).[19]

Finally, throughout the analysis we restrict attention to equilibria in which reserves are strictly positive, $X_t > 0$, so that the reserve optimality condition holds with equality and reserves provide liquidity services at the margin. Alternatively, one could instead impose $M_t > 0$ (or, more generally, require that at least one type of central bank liability be supplied in strictly positive quantity in equilibrium). This requirement is natural: for the model to represent a monetary economy based on a central bank currency, some settlement must occur in central bank liabilities.

We also impose $T_t^C \geq 0$ (non-negative remittances). This restriction is not necessary for existence of equilibrium, but it rules out fiscal support of the central bank—that is, transfers from the Treasury to cover central bank losses. Imposing $T_t^C \geq 0$ is useful because it prevents monetary policy from relying on explicit fiscal backing, which could undermine central bank independence. At the same time, this constraint is potentially binding when policy entails large outstanding liabilities and administered rates that are high relative to the market return on the central bank's asset portfolio.

3. MONETARY POLICY UNDER CENTRAL BANK DIGITAL CURRENCY

Price level and inflation determination are more subtle in this environment because the policy rate on reserves, i_t^x, is not the rate that enters the Fisher equation. Instead, the Fisher equation links inflation to the *market* nominal interest rate, i_t, which is connected to administered rates through endogenous liquidity premia. In particular, the household's optimality condition for reserves implies a wedge between i_t and i_t^x whenever reserves provide marginal liquidity services.[20]

To highlight the role of reserves in inflation determination, we combine the Fisher equation (19) with the reserve pricing condition (20). Using the market clearing condition $C_t = Y$, we obtain:

$$\frac{P_{t+1}}{P_t} = \beta \frac{1 + i_t^x}{1 - \xi_{q,t} V_q \left(\frac{X_t}{P_t} \right)}. \tag{24}$$

Equation (24) describes the gross inflation rate between t and $t+1$ (left-hand side) as a function of the reserve remuneration policy i_t^x and the quantity of reserves X_t (right-hand side), given the current price level P_t and the liquidity-demand shifter $\xi_{q,t}$. The key implication of a CBDC environment is that inflation depends not only on the administered rate i_t^x but also on the supply of reserves, because reserve supply affects the

[18] Note that the central bank cannot set simultaneously the four sequences $\left\{ i_t^x, i_t^m, X_t, M_t \right\}_{t=t_0}^{\infty}$ given the pricing restrictions (20), and (21).

[19] We refer to i_t as the market (credit-market) nominal interest rate. By contrast, i_t^x and i_t^m are administered remuneration rates set by the central bank on reserves and tokens, respectively. When we use the term *policy rate*, we mean the administered rate on reserves, i_t^x.

[20] This "administered-rate vs. market-rate" wedge is a standard implication of operating frameworks with interest on reserves and liquidity services; see, e.g., Goodfriend (2002) and Bindseil (2014). For a discussion of implementation under abundant reserves (floor systems) and the associated decoupling between balance-sheet size and short-term rates, see Keister, Martin, and McAndrews (2008).

liquidity premium and, consequently, the market rate i_t that prices intertemporal substitution.

More concretely, for fixed P_t and i_t^x, an increase in X_t reduces the marginal liquidity value $V_q(X_t/P_t)$ and therefore raises the denominator in (24). This lowers P_{t+1}/P_t, effectively reducing inflation (or increasing deflation). In a flexible-price endowment economy, this is the natural general-equilibrium counterpart to a reduction in the market nominal rate: lower nominal returns are associated with a lower growth rate of the price level.[21]

Equation (24) is also useful for understanding policy rules. For example, if the central bank sets i_t^x according to a Taylor-type feedback rule,[22] inflation dynamics are governed by the interaction between that feedback and the evolution of the reserve liquidity premium (which depends on X_t/P_t and $\xi_{q,t}$).

Because both reserves and tokens provide liquidity services, the model delivers two liquidity pricing conditions: one for reserves and one for tokens. Combining (20) and (21) yields a relationship between the remuneration rates on the central bank's liabilities:

$$\frac{1+i_t^x}{1+i_t^m} = \frac{1-\xi_{q,t}\, V_q\left(\dfrac{X_t}{P_t}\right)}{1-\xi_{h,t}\, L_h\left(\dfrac{M_t}{P_t}\right)}. \tag{25}$$

Equation (25) demonstrates that administered rates and quantities cannot be chosen independently. At a given date t, the central bank manages four policy-relevant objects related to its liabilities: (i_t^x, X_t) and (i_t^m, M_t). Household optimality and market clearing impose two equilibrium conditions (one for each liability). As a result, a policy that *fixes* both (i_t^x, X_t) leaves, in general, only one degree of freedom on the token side: the central bank can either (i) set i_t^m and let the equilibrium determine M_t (token supply becomes demand-determined), or (ii) set M_t and let the equilibrium determine i_t^m (token remuneration becomes endogenous). In what follows, we adopt the first interpretation.[23]

Importantly, there is no presumption that i_t^x must exceed i_t^m. The ranking of the administered rates depends on policy choices and on the relative liquidity premia implied by $V_q(\cdot)$ and $L_h(\cdot)$. The reverse ordering, $i_t^m > i_t^x$, is feasible if the central bank chooses to subsidize token holdings relative to reserves. Moreover, in a purely digital framework there is no requirement that administered remuneration rates be non-negative: the central bank can set the token remuneration rate i_t^m below zero if it so chooses.[24]

Equation (24) governs the *evolution* of the price level, but it does not, by itself, pin down the *initial* price level. In particular, (24) is a forward recursion: given P_t, policy objects at t, and $\xi_{q,t}$, it determines P_{t+1}. To obtain a unique equilibrium price path, one must additionally specify an initial nominal anchor. In this model, the natural anchor is provided by the remittance policy and the economy's intertemporal resource

[21] In models with nominal rigidities, the short-run effects of reserve expansions can raise output through standard New Keynesian mechanisms; see, e.g., Benigno and Benigno (2021, 2022); Piazzesi, Rogers, and Schneider (2021).

[22] See Taylor (1993) and Clarida, Galí, and Gertler (1999) for canonical discussions of interest-rate feedback rules and their role in stabilization policy.

[23] Assuming that the central bank can jointly control i_t^x and X_t is a convenient institutional benchmark. Alternative operational frameworks can be represented by taking X_t as demand-determined given i_t^x, or by imposing an implementation constraint linking reserve supply to administered rates; see Bindseil (2014) and Keister, Martin, and McAndrews (2008).

[24] The effective lower bound in conventional systems is tightly connected to the existence of physical cash (or other instruments with a zero nominal return). In a sufficiently cashless or fully digital setup, negative administered rates are feasible in principle; see, e.g., Buiter (2009), Agarwal and Kimball (2015), and Rogoff (2016).

constraint, consistent with the central bank theory of the price level emphasized by Benigno (2020, 2025a).

We adopt a simple remittance rule that is analytically convenient. The rule rebates net interest income from the central bank's asset portfolio and includes a constant real component:

$$\frac{T_t^C}{P_t} = (1-\beta)\tau^C + i_{t-1}\left(\frac{B_{t-1}^C + D_{t-1}}{P_t}\right) - i_{t-1}^x \frac{X_{t-1}}{P_t} - i_{t-1}^m \frac{M_{t-1}}{P_t}, \tag{26}$$

where $\tau^C > 0$ is a constant governing the real component of transfers. The remaining terms represent net interest income in real terms: the central bank earns the market rate on its holdings of Treasury and private assets and pays the administered rates on reserves and tokens.[25]

Assumption 1 (Monetary policy and remittances)**.** Monetary policy specifies sequences of interest rates $\{i_t^x, i_t^m\}_{t=t_0}^{\infty}$, reserve supply $\{X_t > 0\}_{t=t_0}^{\infty}$, and private-asset holdings $\{D_t \geq 0\}_{t=t_0}^{\infty}$. Remittances satisfy the rule (26) with $\tau^C > 0$.

To determine the price level, we substitute the remittance policy (26) into the central bank's intertemporal budget constraint (23). The initial price level is determined by:

$$P_{t_0} = \frac{(1+i_{t_0-1})(B_{t_0-1}^C + D_{t_0-1} - X_{t_0-1} - M_{t_0-1})}{\tau^C}, \tag{27}$$

provided that initial assets exceed liabilities (i.e., the central bank's initial net worth is positive).

Proposition 1 (Price level determination)**.** *Given the monetary policy specified in Assumption 1, the sequence of prices* $\{P_t\}_{t=t_0}^{\infty}$ *is determined by (27) at time* t_0 *and recursively by (24) for all* $t > t_0$*, provided* $B_{t_0-1}^C + D_{t_0-1} > X_{t_0-1} + M_{t_0-1}$ *and* $1 - \xi_{q,t} V_q(X_t/P_t) > 0 \quad$ *for all* $t \geq t_0$*.*

Proposition 1 clarifies two points. First, the remittance rule fixes a stream of real "dividends" paid by the central bank, which must be supported by the real value of its initial nominal net worth; the initial price level adjusts to satisfy this valuation relationship. Second, once the initial price is pinned down, monetary policy affects the inflation path through both the administered reserve rate i_t^x and the reserve supply X_t, as seen in (24). Moreover, unless reserves are satiated (so that $V_q(\cdot) = 0$), liquidity-demand shocks $\xi_{q,t}$ also affect inflation by shifting the reserve liquidity premium.

In Assumption 1, we treat purchases of private assets as a policy object, while the central bank's holdings of Treasury debt adjust endogenously. To make this precise, we substitute the remittance rule (26) into the central bank flow budget constraint (12). After cancelling net interest income terms, the law of motion for

[25] The remittance rule (26) is analytically convenient, but it is not innocuous. By rebating the central bank's net interest income on its asset portfolio, the rule effectively neutralizes a potentially important source of resources: the seigniorage-like revenues associated with earning the market return on assets while remunerating liabilities at administered rates. These revenues can provide implicit backing for central bank liabilities and thereby affect price-level determination (see Benigno and Nisticò (2025)). Allowing this channel would introduce a direct interaction between the supply of liquidity and the nominal anchor, because changes in liability issuance and in administered rates would translate into systematic movements in remittances and hence in the valuation equation pinning down prices. We abstract from this interaction here in order to isolate the mechanisms emphasized in the text. If anything, incorporating portfolio-income backing would reinforce our conclusions about the joint role of balance-sheet policy and administered rates in shaping equilibrium liquidity premia and inflation dynamics.

the central bank's nominal net worth becomes:

$$(D_t + B_t^C - X_t - M_t) = (D_{t-1} + B_{t-1}^C - X_{t-1} - M_{t-1}) - (1-\beta)P_t\tau^C. \tag{28}$$

Thus, once the price level sequence $\{P_t\}$ is determined, the evolution of central bank net worth is pinned down mechanically by τ^C, and the composition of the asset portfolio adjusts accordingly.

Using (27) and (28), it follows that real central bank net worth remains constant over time:

$$\frac{D_t + B_t^C - X_t - M_t}{P_t} = \beta\tau^C. \tag{29}$$

A practical implication of the equation above is that restrictions such as $B_t^C \geq 0$ impose upper bounds on feasible private-asset holdings $\{D_t\}$ for given liability policies $\{X_t, M_t\}$ and the implied price path. For example, a sufficient condition ensuring that the central bank can avoid negative Treasury holdings is that private-asset purchases remain bounded relative to the scale of its issued liabilities and net worth.

Finally, the equilibrium sequence of tokens is endogenously determined by (25).

The next proposition summarizes how Treasury bond holdings and token quantities are determined in equilibrium under our policy specification.

Proposition 2 (Treasury holdings and token quantity)**.** *Suppose Assumption 1 holds and the equilibrium price sequence $\{P_t\}_{t=t_0}^{\infty}$ is determined as in Proposition 1. Then: i) the sequence of central bank treasury holdings $\left\{B_t^C\right\}_{t=t_0}^{\infty}$ is determined by (29), provided an appropriate upper bound on the sequence $\{D_t\}_{t=t_0}^{\infty}$; ii) the equilibrium sequence of tokens supplied $\{M_t\}_{t=t_0}^{\infty}$ is determined by (25), provided $1-\xi_{h,t}\, L_h(M_t/P_t) > 0$ for all t.*

We are now in a position to discuss the supply of liquidity and the conditions under which liquidity is fully satiated. Since $V(\cdot)$ and $L(\cdot)$ are increasing and concave, welfare is increasing in q_t and h_t up to the satiation thresholds $\bar{q}$ and $\bar{h}$. However, holding reserves and tokens is costly whenever their administered returns are below the market return; these opportunity costs are captured by the user costs u_t^x and u_t^m in the household intertemporal budget constraint.

Full satiation eliminates the liquidity wedges: if both instruments are satiated, then $V_q(\cdot) = 0$ and $L_h(\cdot) = 0$, and the pricing conditions imply $i_t = i_t^x = i_t^m$. In this case, administered rates coincide with the market rate and user costs are zero.

Consider first satiation of reserves. Reserve satiation requires

$$\frac{X_t}{P_t} \geq \bar{q}. \tag{30}$$

When $V_q(\cdot) = 0$, the reserve wedge disappears and $i_t = i_t^x$. The Fisher equation then implies the price dynamics

$$\frac{P_{t+1}}{P_t} = \beta(1 + i_t^x).$$

Thus, once P_{t_0} is pinned down by (27), the subsequent price path is governed by the administered reserve rate when reserves are satiated.

Token satiation depends on how token policy is specified. Under our maintained policy interpretation (the central bank sets i_t^m and token quantities adjust endogenously), token satiation requires setting the token remuneration rate equal to the market rate. If reserves are satiated, this can be achieved by setting

$$i_t^m = i_t^x,$$

which implies $i_t^m = i_t$ and therefore forces the token liquidity premium to zero. The token optimality condition then implies

$$\frac{M_t}{P_t} \geq \bar{h}. \tag{31}$$

When $L_h(\cdot) = 0$, token demand is consistent with any token supply above the threshold $\bar{h}$.

We can combine (29), (30) and (31) to obtain

$$\frac{D_t + B_t^C}{P_t} \geq \beta\tau^C + \bar{h} + \bar{q}.$$

The optimal supply of liquidity should be supported by a sufficient amount of asset holdings, either private or treasury bonds. There should be a sufficient amount of these assets available.

Proposition 3 (Optimal supply of liquidity)**.** *Suppose Assumption 1 holds, then a welfare-maximizing liquidity policy achieves satiation in both liquidity markets. In particular, it suffices to (i) supply reserves so that*

$$\frac{X_t}{P_t} \geq \bar{q} \quad \text{for all } t \geq t_0,$$

and (ii) set the token remuneration rate equal to the reserve remuneration rate,

$$i_t^m = i_t^x \quad \text{for all } t \geq t_0.$$

In equilibrium this implies $V_q(q_t) = 0$ and $L_h(h_t) = 0$, so the liquidity premia on both reserves and tokens are zero and $i_t = i_t^x = i_t^m$.

It is worth discussing Proposition 3 in light of current CBDC proposals that do not contemplate remuneration of tokens.[26] In such designs, $i_t^m = 0$ by assumption. In the present framework, token satiation requires eliminating the token liquidity premium. From the token pricing condition (21) (or, equivalently, from (10)), token satiation ($L_h(h_t) = 0$) requires that the token remuneration rate coincide with the market nominal rate, i.e. $i_t^m = i_t$. Therefore, if tokens are non-remunerated ($i_t^m = 0$), full token satiation can occur only if the market nominal rate is zero, $i_t = 0$. Moreover, if the central bank simultaneously aims to satiate reserves, then reserve satiation implies $i_t = i_t^x$, and thus full satiation of *both* instruments with non-remunerated tokens requires $i_t^x = 0$ as well. In short, token non-remuneration sharply restricts the set of monetary policies consistent with full liquidity satiation.

When tokens are not satiated, their equilibrium quantity generally becomes sensitive to both liquidity-demand shocks and monetary policy. Intuitively, holding tokens entails an opportunity cost that depends on the wedge between the market rate i_t and the token rate i_t^m. If i_t^m is fixed at zero, then (i) variation

[26] For example, non-remuneration and quantitative limits are central design features in the digital euro project; see ECB (2023) and ECB (2025).

in the token-specific liquidity shifter $\xi_{h,t}$ affects token demand directly through $L_h(\cdot)$, and (ii) variation in reserve-market conditions—including the reserve liquidity shifter $\xi_{q,t}$ and reserve policy (i_t^x, X_t)—affects token demand indirectly through its impact on the market rate i_t (and thus on the opportunity cost of holding tokens). This is captured formally by the spread relationship (25), which links the two administered rates to the two liquidity premia.

By contrast, satiation of reserves can be achieved independently of the token remuneration rate. Reserve satiation is a statement about the marginal liquidity value of reserves: it requires that reserves be supplied abundantly enough that $V_q(q_t) = 0$, i.e.,

$$\frac{X_t}{P_t} \geq \bar{q}.$$

This condition does not involve i_t^m and therefore can be implemented even under non-remunerated tokens. In that case, reserves can be abundant while tokens remain scarce in liquidity-service terms.

Even in the idealized case in which the central bank is able to achieve full satiation in both markets, several practical considerations arise. First, two distinct requirements must be satisfied. Setting $i_t^m = i_t^x$ is straightforward in principle because both rates are administered. However, by itself this restriction only equalizes the wedges (liquidity premia) across the two liability markets; it does *not* guarantee that the premia are zero. Full satiation requires, in addition, an abundant supply of reserves so that $V_q(q_t) = 0$. Once reserve satiation holds, the reserve pricing condition implies $i_t = i_t^x$, and the additional restriction $i_t^m = i_t^x$ then implies $i_t^m = i_t$, which forces the token liquidity premium to be zero and therefore implies $L_h(h_t) = 0$.

Second, implementing reserve satiation may not be straightforward in practice because the central bank needs to assess not only the current price level P_t but also the satiation threshold $\bar{q}$, which may vary over time (for example, with changes in payment technologies, regulation, or the functioning of collateral markets). A practical indicator of non-satiation is the persistence of liquidity premia. In the model, non-satiation manifests itself as spreads between the market rate and administered rates, $i_t - i_t^x$ and $i_t - i_t^m$. Policies that drive these spreads toward zero correspond to policies that move the economy toward the satiated region.

Third, a policy that targets abundant central bank liabilities naturally raises questions about balance-sheet backing and the safety of the asset side of the central bank. In the baseline model, central bank assets are riskless and pay the market rate i_t, so expanding the balance sheet by issuing liabilities to purchase safe assets does not mechanically reduce net worth. However, once one moves beyond the riskless benchmark, large-scale asset holdings can expose the central bank to valuation losses or default risk. Such losses matter here because price-level determination relies on the intertemporal resource constraint (23) and on a positive initial net worth. If asset risk erodes net worth, it can compromise the mechanism that pins down the initial price level or alter the implied inflation path.

More generally, under full satiation the user-cost terms associated with issuing reserves and tokens vanish. In this case, the intertemporal resource constraint of the economy reduces to a valuation relationship in which the present discounted value of real remittances is pinned down by the initial real net worth of the central bank. As a result, any remittance policy that commits the central bank to strictly positive real transfers must ultimately be supported either by positive initial net worth (backed by sufficiently safe assets) or by an explicit fiscal backstop.[27] As discussed in Bassetto and Messer (2013); Benigno and Nisticò (2020); Del

[27] In the full-satiation (first-best) allocation for households, rebating or not rebating interest income through the remittance rule (26) makes no difference for equilibrium allocations. The reason is that, under full satiation, liquidity premia vanish, so the user-cost

Negro and Sims (2015); Hall and Reis (2015), price determination can be sustained even after asset losses through a recapitalization of the central bank. However, this creates a deep fiscal interdependence between the central bank and the Treasury.

Finally, large balance-sheet policies may generate additional distortions outside the scope of the baseline model. If the central bank acquires large quantities of private or government securities, this may affect incentives in the financial and fiscal sectors. For example, the prospect of sustained central bank demand for certain assets can encourage excessive issuance or risk-taking, potentially amplifying moral hazard and increasing the risk of financial or fiscal dominance.[28]

When liquidity is not satiated, setting the remuneration rate on reserves provides the central bank with a powerful instrument to decouple inflation dynamics from shocks that originate in the token market. Intuitively, token demand shocks $\xi_{h,t}$ affect equilibrium token premia and, through (21)–(25), they can change the equilibrium quantity of tokens M_t. However, conditional on reserve policy, these token-side shocks do not enter the inflation equation (24) directly: inflation is pinned down by the market rate i_t, which is linked to the reserve rate i_t^x through the reserve liquidity premium. As a result, by appropriately setting i_t^x, the central bank can in principle sterilize the path of the price level from demand shocks affecting the token market, even when tokens are not satiated.

By contrast, reserve-demand shocks $\xi_{q,t}$ enter inflation dynamics directly through the reserve liquidity premium in (24). Unless the central bank adjusts either the administered reserve rate i_t^x or the quantity of reserves X_t so as to offset movements in $\xi_{q,t}$, the implied market rate and therefore the inflation path will respond to those shocks. In this sense, the reserve market is the relevant margin for inflation stabilization in the baseline model.

This observation is particularly relevant during episodes of unusually large shifts in liquidity demand—for instance, during financial crises. In such circumstances, the central bank can insulate the price level path by expanding the supply of reserves, thereby reducing the marginal liquidity value of reserves and dampening the increase in the reserve liquidity premium. Under the remittance rule (26), an expansion in reserves must be matched by a corresponding adjustment on the asset side of the central bank balance sheet, i.e., larger holdings of Treasury and/or private securities. Thus, stabilizing prices in the face of large reserve-demand shocks may require an expansion of the central bank balance sheet.

A final implication concerns the exit from crisis conditions. When liquidity demand reverts toward its pre-crisis level, the previously accumulated stock of reserves can become abundant relative to demand. This compresses the liquidity premium, lowers the market nominal rate i_t relative to the administered rate, and — through (24)— tends to reduce subsequent inflation (or increase deflation) in the flexible-price endowment economy. In other words, absent an appropriate unwinding of reserves (or an offsetting adjustment in administered rates), crisis-era balance sheet expansions can become expansionary in liquidity terms when

terms associated with liquidity provision drop out and the marginal liquidity wedges that otherwise link policy rates, balance-sheet quantities, and inflation are absent. If anything, the first-best case reinforces the usefulness of specifying a remittance policy that renders the intertemporal resource constraint independent of interest-rate earnings on the central bank's portfolio. Such a rule neutralizes the direct effect of portfolio income on the valuation equation that pins down the price level, thereby separating price-level determination from fluctuations in asset returns. In this sense, in the satiated region the nominal anchor operates through the remittance component that is exogenously specified (e.g., the constant real transfer), rather than through endogenous variation in interest income.

[28] See Brunnermeier et al. (2016) for a discussion on the "Diabolic Loop" and financial dominance.

the economy normalizes, by pushing the economy toward the satiated region and eroding the wedge between market and administered rates.

4. STABLECOINS AND PRIVATE MONEY

We now enrich the previous framework in two directions by allowing for the issuance of privately supplied liquid claims in addition to central bank liabilities. We proceed in steps. We start with privately issued tokens—a class that includes *stablecoins*—and we later turn to broader forms of private money.

4.1. Stablecoins

Central bank tokens (and, more generally, central bank liabilities) are special because they define the unit of account and constitute the ultimate settlement asset in the economy. In particular, the central bank can issue them *ex nihilo*. By contrast, private agents cannot create dollars, but they can issue *dollar-denominated claims*—synthetic dollars—by issuing liabilities backed by safe assets. Stablecoins are designed to replicate the unit of account as closely as possible: a holder of a dollar stablecoin is promised redemption in dollars, typically at (or close to) par. In general, perfect replication may fail, or issuers may promise a redemption value that differs from one-for-one, for example by paying an interest rate i_t^s.

Following Benigno, Schilling, and Uhlig (2022), we consider a private token issuer that supplies tokens S_t elastically at the exchange rate $\mathcal{E}_t$ (dollars per token). The issuer invests the dollar proceeds in one-period safe assets (Treasury and/or safe private bonds) that yield the market nominal rate i_t. Its balance sheet at time t is therefore

$$B_t^S + D_t^S = \mathcal{E}_t S_t. \tag{32}$$

The composition of assets between B_t^S and D_t^S can be chosen freely.

At time $t+1$, the investments deliver a gross payoff $(1+i_t)(B_t^S + D_t^S)$, of which only the fraction $(1-\delta_{t+1})$ remains available to back token holders. One can interpret δ_{t+1} as intermediation costs, fees, or other frictions—including liquidation costs and redemption/liquidation constraints—that reduce the resources available for redemption. We decompose it into an issuer-controlled component and an exogenous component,

$$\delta_{t+1} = \delta_{t+1}^s + \delta_{t+1}^e.$$

The issuer promises to redeem outstanding tokens at $t+1$ at the exchange rate $\mathcal{E}_{t+1}$ and to pay the gross promised token return $1+i_t^s$. The market exchange rate $\mathcal{E}_{t+1}$ adjusts so that the assets available at $t+1$ are just sufficient to honor this promise. Therefore,

$$(1-\delta_{t+1})(1+i_t)(B_t^S + D_t^S) = (1+i_t^s)\mathcal{E}_{t+1} S_t,$$

and using the balance sheet (32) we obtain

$$\mathcal{E}_{t+1} = \frac{(1-\delta_{t+1}^s - \delta_{t+1}^e)(1+i_t)}{(1+i_t^s)}\mathcal{E}_t.$$

At time $t+1$, taking $\mathcal{E}_{t+1}$ as given, the issuer supplies the demand-determined quantity S_{t+1} and invests again, which pins down $\mathcal{E}_{t+2}$, and so forth. Normalizing $\mathcal{E}_{t_0} = 1$ (one dollar per token) at inception, this law of motion determines the entire exchange-rate sequence.

We say that a *stablecoin* is feasible if the token maintains a stable value in dollars (i.e., it remains at par in the unit of account, given the normalization $\mathcal{E}_{t_0} = 1$). The following result characterizes when this can be achieved.

Proposition 4 (Stablecoins)**.** *A stablecoin is feasible whenever*

$$\delta^s_{t+1} = 1 - \frac{(1+i^s_t)}{(1+i_t)} - \delta^e_{t+1} \geq 0.$$

In a market of free competition $\delta^s_{t+1} = 0$, and therefore

$$(1+i^s_t) = (1+i_t)(1-\delta^e_{t+1}).$$

Proposition 4 implies that the issuer-controlled fee/profit component δ^s_{t+1} must be non-negative for a stablecoin to be sustainable without subsidies. Note also that i^s_t is a choice of the stablecoin issuer, but it is constrained by $\delta^e_{t+1} \geq 0$: under free competition, $i^s_t \leq i_t$. In a richer (stochastic) environment, if i^s_t and/or δ^s_{t+1} are set before the exogenous component δ^e_{t+1} is realized, then the exchange rate $\mathcal{E}_t$ may deviate from par even if the issuer intends to target stability.

Turning to the demand side, suppose that central bank tokens and stablecoins are perfect substitutes in the liquidity-services function $L(\cdot)$. Then we can redefine the token-services aggregate as[29]

$$h_t = \frac{M_t + \mathcal{E}_t S_t}{P_t}.$$

In this case, the optimality condition for central bank tokens (9) should be understood as a Kuhn–Tucker condition: it holds with a weak inequality, with equality when $M_t > 0$. Similarly, under a stablecoin (i.e., when $\mathcal{E}_{t+1} = \mathcal{E}_t$), the first-order condition with respect to S_t is

$$\frac{U_c(C_t)}{P_t} \geq \frac{\xi_{h,t}}{P_t} L_h(h_t) + \beta(1+i^s_t)\frac{U_c(C_{t+1})}{P_{t+1}}, \tag{33}$$

with strict inequality when stablecoins are not held ($S_t = 0$).

Comparing (9) and (33), it is immediate that the relative remuneration of stablecoins and central bank tokens (i.e., i^s_t versus i^m_t) determines which token is held in equilibrium when they are perfect substitutes in $L(\cdot)$.

Proposition 5 (Stablecoins usage)**.** *Under the conditions of Proposition 4, stablecoins are the only tokens used whenever*

$$(1+i_t)(1-\delta^e_{t+1}) > (1+i^m_t).$$

With an equality sign both stablecoins and central bank tokens are used. With <, only central bank tokens

[29] Perfect substitutability is an extreme benchmark. With imperfect substitutability in $L(\cdot)$, coexistence of multiple token-like instruments is generic, while relative demands are still governed by the corresponding pricing wedges.

are used. When stablecoins are used then

$$\frac{\xi_{h,t}\, L_h(h_t)}{U_c(C_t)} = \delta^e_{t+1},$$

and tokens are fully satiated whenever $\delta^e_{t+1} = 0$.

Competition among token-like instruments implies that households hold the instrument delivering the highest *effective* remuneration, once one accounts for redemption frictions and any deviation from par. In the baseline formulation above—where central bank tokens and stablecoins enter the same liquidity-services aggregator $L(\cdot)$ and are treated as perfect substitutes—this competition reduces, in a deterministic environment, to a comparison of their gross returns. If the central bank maintains a low remuneration on tokens, or sets token remuneration to zero (as with cash), there is room for private issuers to displace central bank tokens by offering stablecoins that pay an interest rate i^s_t close to the market rate i_t. Proposition 4 shows that, under free competition, stablecoin remuneration is tied to the market return net of intermediation frictions, $(1 + i_t)(1 - \delta^e_{t+1})$. Thus, the closer δ^e_{t+1} is to zero, the closer stablecoin remuneration can be to the market rate, and the more attractive stablecoins become as a token-like store of value.

In the frictionless benchmark with perfect competition and no exogenous intermediation losses ($\delta^e_{t+1} = 0$), stablecoins can deliver the market return and thereby eliminate the token liquidity wedge. In this sense, the private market can (in principle) push the economy toward the satiated region of the token-liquidity market. However, token satiation is not only a pricing condition; it also requires a sufficient *quantity* of liquid, safe backing assets. Under an equilibrium in which stablecoins are the marginal (or exclusive) provider of token liquidity, full satiation ($h_t \geq \bar{h}$) implies that the issuer must back a large enough nominal quantity of tokens with safe assets. Using the balance sheet (32), this requires

$$\frac{B^S_t + D^S_t}{P_t} \geq \bar{h},$$

that is, the private sector (or the Treasury sector) must be able to supply a sufficiently large stock of safe securities that can credibly serve as stablecoin reserves.

Therefore, two distinct conditions are needed for a competitive stablecoin market to achieve token-liquidity satiation. First, intermediation frictions must be negligible ($\delta^e_{t+1} \approx 0$) so that stablecoins can offer an effective return comparable to market-rate instruments. Second, the economy must have (or be able to produce) enough safe assets to back token issuance at the scale required by $\bar{h}$. Even if stablecoin issuance is demand-elastic, it cannot expand beyond what can be credibly collateralized with safe reserves.

These observations highlight a useful comparison with central bank token supply. In the central-bank regime, Proposition 3 showed that token satiation can be obtained by setting $i^m_t = i_t$ (or, in the satiated-reserve benchmark, by setting $i^m_t = i^x_t = i_t$), *and* by ensuring that the central bank has a sufficiently large asset position to support the desired scale of liabilities. In the stablecoin regime, the private sector performs the same economic function—issuing liquid claims and backing them with safe assets—but the backing takes place on private balance sheets rather than on the central bank balance sheet.

From a purely theoretical perspective, and under the maintained assumptions of riskless backing and perfect substitutability in $L(\cdot)$, there is therefore no sharp distinction between public and private token provision:

in both cases, satiation ultimately requires an abundant supply of safe assets somewhere in the economy. The difference is institutional and risk-distributional. Under central bank provision, reserve backing and balance-sheet risks are concentrated in a single public intermediary; under private provision, backing assets are distributed across many issuers and investors.

There are, however, important advantages and drawbacks that become salient once one allows for realistic frictions.

First, central bank tokens define the unit of account and are therefore *pinned at par by construction*. In the model, one unit of central bank token is one unit of currency. Private stablecoins, by contrast, can deviate from par if intermediation frictions rise (a larger δ^e_{t+1}) or if reserve assets are not perfectly safe. In those circumstances, the market exchange rate $\mathcal{E}_t$ can fall below parity, reducing effective real token liquidity h_t and generating a contraction in liquidity services. More practically, a decline in h_t, which could be labelled a crisis event, should be interpreted as reflecting a loss of real resources somewhere in the economy associated with the provision of token-based liquidity services—for example, through liquidation costs, operational costs, or inefficient resource use triggered by runs or redemption frictions—and therefore as an outcome to which policymakers should pay close attention.

This fragility is also informative: deviations of $\mathcal{E}_t$ from par provide a market-based signal of stress, revealing whether an issuer's balance sheet can in fact replicate the dollar. But the same market-based discipline can come with abrupt and potentially inefficient liquidity contractions if the system is run-prone or if information frictions are large.

Second, private provision can reduce the need for the central bank to expand its own balance sheet to satisfy token liquidity demand. In a regime where stablecoins supply most token services, the central bank can focus its balance-sheet policy on reserves and on price-level determination, while private issuers intermediate the backing assets for token-like claims. This separation can be desirable if expanding the central bank's balance sheet is politically constrained or exposes the central bank to concentrated asset risk. At the same time, this does not eliminate the fundamental issue that safe backing assets must exist and must remain safe. If stablecoin reserves are exposed to default or valuation risk, losses can be transmitted through the token market via de-pegging. In that case, the question of whether and how the monetary authority backstops the stablecoin system becomes central.

Importantly, under the maintained assumptions of the baseline model, the presence of stablecoins does not interfere with price-level control. The reason is that stablecoin-side shocks affect the token-liquidity margin (hence h_t and $\mathcal{E}_t$), but do not enter the reserve pricing condition that governs the market rate i_t and inflation dynamics. In particular, Proposition 1 continues to hold: the equilibrium price level is pinned down by reserve policy and by the nominal anchor provided by remittances, and inflation evolves according to (24) given reserve policy and reserve-side liquidity conditions. Stablecoin market conditions affect the composition of token holdings but do not determine the inflation path.

Proposition 6 (Price level determination)**.** *In a stablecoins market, Proposition 1 holds.*

An advantage of stablecoin provision is therefore that it can insulate the central bank's *price-level control* from token-market disturbances. In particular, stablecoin-side shocks that alter δ^e_{t+1} or token demand translate into movements in h_t and potentially in $\mathcal{E}_t$, but they do not enter the inflation equation (24).

This insulation property, however, should not be interpreted as a general statement of desirability. If a stablecoin disruption reduces h_t and thereby generates real costs in parts of the economy (for instance through liquidation frictions, fire sales, or payment disruptions), then some of the adjustment might efficiently occur through the aggregate price level rather than being fully absorbed by quantities. In other words, while the model highlights that token-market disturbances need not mechanically destabilize the inflation path, it does not follow that complete insulation of the price level is optimal from a welfare perspective in a second best world.

Moreover, the existence of a central bank token (or, more generally, reserves) provides a natural fallback that can also strengthen price-level control. When stablecoins de-peg and become less attractive, households can substitute back into central bank liabilities. In crisis-like episodes, the central bank can support overall liquidity conditions by adjusting administered rates (for example, raising i_t^m if it chooses to use token remuneration as a stabilization tool), thereby limiting inefficient contractions in liquidity services.

Overall, the analysis favors the availability of a digital central bank token that can remain quantitatively small in normal times but credibly emerge as a backstop in stress states, when private token liquidity contracts and the demand for safe public liquidity rises.

Regulation provides an additional margin for stabilizing the system by reducing the volatility and level of δ_{t+1}^e (e.g., via reserve asset restrictions, disclosure and audit requirements, segregation of reserves, redemption rules, and limits on rehypothecation). In principle, improvements in transparency and monitoring technologies (including on-chain verification and automated compliance tools) may reduce some information costs. However, technological developments in this direction remain uncertain, even if they are promising.

Finally, it is useful to consider a financially repressed stablecoin regime in which issuers are prohibited from paying interest (or yield) to token holders. This resembles key elements of the U.S. GENIUS Act (approved July 18, 2025), including a prohibition on paying interest or yield and restrictions on eligible reserve assets.[30]

Proposition 7 (Financial repressed Stablecoins)**.** *Under the monetary policy of Assumption 1, when regulation set interest rate on stablecoins $i_t^s = i_t^m = 0$ then this does not change the equilibrium tokens supplied in the system.*

The restriction $i_t^s = i_t^m = 0$ implies an appropriate version of (25):

$$1 + i_t^x = \frac{1 - \xi_{q,t} V_q \left(\dfrac{X_t}{P_t} \right)}{1 - \xi_{h,t} L_h \left(h_t \right)}. \tag{34}$$

Equation (34) is residually determined given monetary policy, the price path pinned down by Proposition 1, and the fact that, under perfect substitutability, the *total* token-liquidity aggregate h_t depends on the equilibrium wedge between the market rate and token remuneration, not on whether tokens are supplied publicly or privately. If stablecoins are held in equilibrium in the financially repressed regime, their holdings crowd out central bank tokens one-for-one within h_t.

More generally, suppressing token remuneration (whether for public tokens or stablecoins) lowers token demand relative to the satiated benchmark and makes token liquidity more sensitive to liquidity shocks. In

[30] See the GENIUS Act text for the prohibition on interest/yield and the list of permitted reserve assets.

addition, restrictions on the reserve portfolio of stablecoin issuers—for example, a requirement to back tokens predominantly with short-term Treasury securities—tighten the link between token liquidity provision and the supply of public debt. This can shift the burden of liquidity provision toward fiscal capacity and may raise the effective demand for Treasury bills used as reserves, an issue that becomes central in Section 5.

4.2. Private money

We now allow a competitive intermediary sector to issue *private money* that competes with central bank reserves in providing liquidity services to households through the function $V(\cdot)$. Specifically, we assume that the relevant liquidity aggregate entering $V(\cdot)$ is

$$q_t \equiv \frac{X_t + A_t}{P_t},$$

where A_t denotes private money (deposit-like liabilities) issued by intermediaries and held by households.[31]

We consider stylized intermediaries that at time t issue one-period nominal liabilities A_t promising a gross return $1 + i_t^a$ and invest the proceeds in one-period safe assets (private and/or Treasury debt) earning the market nominal rate i_t. Their balance sheet is

$$D_t^A + B_t^A = A_t, \tag{35}$$

where D_t^A and B_t^A denote holdings of private and Treasury securities, respectively.

Intermediation is subject to resource losses. The intermediary's next-period profits are

$$\Psi_{t+1}^A = (1 + i_t)(1 - \delta_{t+1}^a)(D_t^A + B_t^A) - (1 + i_t^a)A_t,$$

where $\delta_{t+1}^a \geq 0$ captures transaction and monitoring costs, operating costs, and other intermediation wedges that reduce the resources available to service liabilities. More broadly, δ_{t+1}^a can be interpreted as a reduced-form representation of *funding and balance-sheet frictions*, including losses associated with default risk and liquidity risk. A natural extension would be to introduce an explicit equity layer (or other loss-absorbing capital), so that adverse shocks are borne partly by equity rather than being summarized by an exogenous wedge, and to allow the intermediary's liability pricing and quantity to depend on capital constraints and risk exposures. It should be then understood that certain balance-sheet and equity requirements can influence δ_{t+1}^a.

Proposition 8 (Banking equilibrium)**.** *In an intermediaries market of perfect competition with*

$$(1 + i_t)(1 - \delta_{t+1}^a) = (1 + i_t^a) \tag{36}$$

and under the monetary policy of Assumption 1 with $\frac{X_t}{P_t} \leq \bar{x}_t \leq \bar{q}$ *for an appropriate* $\bar{x}_t$*, it follows*

$$(1 + i_t^a) = (1 + i_t^x) \tag{37}$$

[31] We continue to treat the liabilities in this subsection as default-free claims in the unit of account. The analysis can be enriched to allow for default risk, maturity transformation, equity issuance, reserve requirements, and collateral constraints. The goal here is to isolate the key equilibrium wedge created by intermediation costs.

$$\frac{\xi_{q,t}\, V_q(q_t)}{U_c(C_t)} = \delta^a_{t+1}, \tag{38}$$

and debt securities providing liquidity are fully satiated whenever $\delta^a_{t+1} = 0$.[32]

Equation (36) follows from the zero-profit condition under perfect competition applied to Ψ^A_{t+1}, using (35). The more subtle restriction is (37). Intuitively, reserves and private money enter the same liquidity aggregator $V(\cdot)$ and are therefore perfect substitutes in providing liquidity services at the margin. Under our maintained policy specification, the central bank chooses the reserve quantity X_t and the administered reserve rate i^x_t *simultaneously*. This joint control is a distinctive feature of the monetary authority in a fiduciary currency system: unlike any other debtor in the economy, the central bank can fix both the quantity and the price (remuneration) of its own liabilities. As a consequence, when we restrict attention to equilibria with $X_t > 0$, households must be willing to hold reserves even in the presence of competing private money.

This delivers a sharp arbitrage logic. If $i^a_t < i^x_t$, then private money is strictly dominated by reserves as a liquidity instrument (it provides the same liquidity services but offers a lower pecuniary return), so demand for A_t is zero. If, instead, $i^a_t > i^x_t$, then reserves are strictly dominated by private money, and households would strictly prefer to set $X_t = 0$ at the margin. Since we focus on equilibria and policies with $X_t > 0$ and with the reserve optimality condition holding with equality, the only possibility in a banking equilibrium with active private money is the no-arbitrage condition $i^a_t = i^x_t$, which is (37).[33]

Combining (36) and (37) yields

$$\frac{(1 + i^x_t)}{(1 + i_t)} = (1 - \delta^a_{t+1}),$$

which, together with the household reserve optimality condition (7) (or its equilibrium counterpart), implies (38). Equation (38) provides a clean interpretation of banking frictions: in a banking equilibrium, the *liquidity premium* on reserves/private money is pinned down by the intermediation wedge δ^a_{t+1}. When intermediation becomes more costly, liquidity premia must rise to compensate intermediaries, and the economy operates further away from the satiated region.

A key requirement for the existence of a banking equilibrium is that the central bank does *not* supply reserves too abundantly. If reserves are very large, the marginal liquidity value $V_q(X_t/P_t)$ is too small to generate the liquidity rents needed to cover δ^a_{t+1}. Formally, a necessary condition for private money to be held is that the reserve supply leave room for a strictly positive liquidity premium,

$$\frac{\xi_{q,t}\, V_q\left(\frac{X_t}{P_t}\right)}{U_c(C_t)} \geq \delta^a_{t+1},$$

which implies

$$\frac{X_t}{P_t} \leq V_q^{-1}\left(\frac{\delta^a_{t+1}}{\xi_{q,t}}\right) = \bar{x}_t.$$

Thus, in normal times when intermediation frictions are small, a relatively small reserve supply can coexist with an active private money sector. In contrast, if intermediation frictions spike, $\bar{x}_t$ falls and the reserve

[32] $\bar{x}_t$ is equal to $V_q^{-1}\left(\frac{\delta^a_{t+1}}{\xi_{q,t}}\right)$.

[33] Perfect substitutability in $V(\cdot)$ is an extreme benchmark. With imperfect substitutability, coexistence of $X_t > 0$ and $A_t > 0$ does not require equal returns, but the same wedge logic continues to govern relative demands.

supply consistent with private money issuance becomes tighter.

In a banking equilibrium, total real liquidity is pinned down by (38). In particular, for given X_t, private money adjusts so that

$$\frac{X_t + A_t}{P_t} = \bar{x}_t,$$

with the residual $A_t = P_t\bar{x}_t - X_t$ provided by intermediaries. When intermediation is frictionless ($\delta^a_{t+1} = 0$), (38) implies $V_q(q_t) = 0$ and hence $q_t \geq \bar{q}$: the reserve/private-money market is fully satiated.

There are important implications of this framework for inflation and for the supply of liquidity.

Proposition 9 (Price level determination)**.** *In a banking equilibrium*

$$\frac{P_{t+1}}{P_t} = \beta \frac{1 + i^x_t}{1 - \delta^a_{t+1}} \tag{39}$$

Proposition 9 shows that inflation dynamics depend on both the administered reserve rate i^x_t and the intermediation wedge δ^a_{t+1}. For a fixed path of i^x_t, an increase in banking frictions (a rise in δ^a_{t+1}) raises the market nominal rate consistent with intermediary break-even and equilibrium liquidity premia, and therefore increases P_{t+1}/P_t in the flexible-price endowment benchmark. In models with nominal rigidities, the same increase in the wedge would typically be contractionary because it raises effective borrowing or credit-market rates relative to administered rates; in that case, the natural policy response is to lower administered rates to offset a widening spread. This logic captures, in reduced form, why episodes of financial disruption often coincide with policy-rate cuts and with interventions aimed at compressing spreads.

The framework also clarifies the role of reserve quantity policy when the banking sector is impaired. Because private money issuance requires that reserves not be too abundant (so that liquidity rents exist), an expansion of reserves can *crowd out* private money by reducing the liquidity premium below what is needed to cover δ^a_{t+1}. In that sense, reserve supply can substitute for private money in crisis states: when δ^a_{t+1} rises and the private sector cannot profitably provide liquidity, the central bank can expand X_t to sustain overall liquidity conditions.[34] Conversely, in normal times when δ^a_{t+1} is small, it can be efficient for the central bank to keep reserves relatively scarce and allow intermediaries to provide a significant share of liquidity services.

Importantly, the *nominal anchor* in the model is unchanged. As in the baseline economy, the initial price level is pinned down by the central bank's remittance policy and intertemporal resource constraint (e.g., by (27) under Assumption 1). This feature rationalizes the possibility of a small central bank balance sheet in normal times: price-level determination can be achieved through remittances and reserve remuneration policy, while private money provision is largely delegated to intermediaries.

Turning to optimal liquidity supply, the frictionless benchmark $\delta^a_{t+1} = 0$ illustrates a close parallel with the stablecoin case. Under perfect competition and negligible intermediation losses, the banking sector can (in principle) push the economy toward the satiated region of the reserve/private-money liquidity market. But, again, satiation requires not only favorable pricing (low wedges) but also a sufficient quantity of safe backing assets. Using (35), full satiation of $V(\cdot)$ requires a sufficiently large stock of securities on intermediary

[34] See Benigno and Robatto (2019), Greenwood, Hanson, and Stein (2015), and Magill, Quinzii, and Rochet (2020) for related analyses in which public balance-sheet expansions can substitute for impaired private liquidity creation and affect liquidity premia.

balance sheets:

$$\frac{X_t + D_t^A + B_t^A}{P_t} \geq \bar{q}.$$

Thus, even when δ_{t+1}^a is small, liquidity provision ultimately relies on the availability of safe assets that can credibly back liquid claims. In this sense, the model again emphasizes the centrality of safe asset supply for the provision of abundant liquidity.

The private-money regime shares the key *benefit* of the stablecoin regime: it can supply liquidity services without requiring the central bank to expand its balance sheet one-for-one with the demand for liquid claims. In normal times, a large share of liquidity can be provided by competitive intermediaries, leaving the central bank to focus on the nominal anchor and on the design of administered rates.

At the same time, private money differs from stablecoins in a critical way: it competes directly with reserves inside $V(\cdot)$, which is the margin that governs the wedge between the market rate i_t and the administered reserve rate i_t^x. As a result, shocks to intermediation efficiency δ_{t+1}^a feed into the equilibrium market rate and therefore into inflation dynamics via (39). In this sense, the banking sector can be a direct source of inflation volatility (or, with nominal rigidities, of real activity volatility) unless monetary policy responds appropriately.

The model also mirrors the stablecoin discussion in its implications for crisis management and regulation. A sudden deterioration in intermediation technology (a spike in δ_{t+1}^a) reduces the efficient scale of private liquidity provision and can generate an abrupt contraction in liquidity services unless the central bank expands reserves or adjusts administered rates. Regulatory tools—capital and liquidity requirements, supervision of asset quality, reserve requirements, or policy backstops that stabilize the intermediary funding base—can be interpreted as mechanisms that reduce the level and volatility of δ_{t+1}^a, thereby lowering the equilibrium liquidity premium and stabilizing inflation and liquidity provision. But these tools also create familiar trade-offs: tighter regulation can improve stability at the cost of reducing private liquidity creation and increasing the burden on central bank balance-sheet policy.

Finally, as in the stablecoin case, the existence of an outside public option (reserves) limits the scope for destabilizing feedback loops in the private money market. When private money becomes too costly to provide (high δ_{t+1}^a), the central bank can always expand X_t and, if needed, adjust i_t^x to stabilize the market rate and inflation. In this sense, a CBDC/reserve regime provides an elasticity of public liquidity that can discipline private money issuance in normal times and replace it in stress states—though doing so may require an enlarged central bank balance sheet and raises the same balance-sheet risk and remittance considerations emphasized earlier.

4.3. General considerations on a monetary framework with stablecoins and private money

Integrating the analysis of the previous two sections yields several implications.

First, under the policy specification in Assumption 1, developments in the token market do not interfere with price-level determination in the baseline economy. Price dynamics are pinned down by reserve policy and by the nominal anchor implied by remittances; token-market disturbances affect the composition of token-like instruments but do not enter the reserve pricing condition that links the market rate to the administered reserve rate. By contrast, disturbances originating in the intermediary sector—captured by the wedge δ_{t+1}^a in the private-money market—directly affect the equilibrium liquidity premium in $V(\cdot)$ and therefore propagate to the market rate and inflation. The key feature behind this separation is the central bank's ability to control *both* the quantity of reserves and their remuneration rate. This joint control isolates price determination from events in the token market, while leaving it potentially sensitive to banking-sector frictions that shift the reserve/private-money liquidity premium.[35]

Second, both analyses highlight that private provision can be a viable alternative to public provision of liquidity in each liquidity market. In the token market, competitive stablecoin issuance can replicate token-like liquidity services when intermediation frictions are small. In the reserves market, a competitive intermediary sector can supply deposit-like private money that provides liquidity services similar to reserves. In both cases, private issuance can reduce the need for the central bank to expand its own balance sheet in order to satisfy liquidity demand, at least in normal times.[36]

Third, general equilibrium clarifies that abundant liquidity provision requires two distinct conditions. The first is the *safety* of the liquid claim. Here, central bank liabilities have a natural advantage: they are settlement assets and are default-free *in the unit of account*. By contrast, private liabilities—whether stablecoins or private money—may fail to be riskless if their backing assets are imperfectly safe, if capitalization is insufficient, or if redemption and liquidity frictions rise. These forces can lead to de-pegging (in the stablecoin case) or to a contraction in private money supply (in the banking case). The second condition is *backing*: even when liabilities are designed to be safe, they must be supported by a sufficiently large stock of assets with credible cash flows. When backing assets are risky, safety also requires a sufficient buffer of loss-absorbing capital (e.g. equity or subordinated claims) to protect the promised value of liquid liabilities against valuation losses. Ultimately, that backing comes either from the private sector's capacity to hold and intermediate assets (together with adequate capitalization), or from the Treasury's capacity to back government liabilities via taxation. In this sense, the liquidity-supply problem is inseparable from the economy's asset supply and, in the background, from fiscal capacity.[37]

Fourth, these results suggest no presumption that screening and monitoring should be centralized within the monetary authority. A decentralized and competitive private intermediation sector may have stronger incentives and greater specialized expertise to screen collateral quality, monitor issuers, and innovate in payment services—especially when supported by appropriate regulatory standards that limit excessive risk-taking. By contrast, a central bank that assumes a dominant role in liquidity provision through a very large balance sheet may face political-economy and risk-management challenges. Concentrated asset exposures can generate valuation losses that strain remittances and, in the frameworks studied above, can interact

[35] This logic is closely related to models in which the central bank has (at least) two operating instruments—an administered rate on reserves and the quantity of reserves—and where equilibrium spreads reflect liquidity premia; see Goodfriend (2002), Bindseil (2014), and, in New Keynesian environments with reserve liquidity services, Benigno and Nisticò (2017), Benigno and Benigno (2021), Benigno and Benigno (2022), Diba and Loisel (2021) and Piazzesi, Rogers, and Schneider (2021).

[36] For equivalence and "swap" results between public and private money under strong neutrality conditions, see Brunnermeier and Niepelt (2019). For evidence and mechanisms relevant to stablecoin peg maintenance and arbitrage, see Lyons and Viswanath-Natraj (2023); for historical parallels between stablecoins and private money and the role of backing and regulation, see Gorton and Zhang (2023).

[37] On fragility and run risk in money-like liabilities, see Diamond and Dybvig (1983) and the broader "private money" literature including Gorton and Pennacchi (1990) and Holmström (2015). On the convenience yield and macro-finance importance of safe assets, see Krishnamurthy and Vissing-Jorgensen (2012) and Nagel (2016), and on safe-asset scarcity, see Caballero, Farhi, and Gourinchas (2017). On fiscal capacity and price-level determination, see Leeper (1991), Sims (1994), Woodford (1995), and Cochrane (2023); on balance-sheet constraints and fiscal support for the central bank, see Del Negro and Sims (2015) and Hall and Reis (2015).

with price-level determination through the balance-sheet channel. Moreover, a large and persistent central bank footprint in asset markets may increase the risk of financial or fiscal dominance by altering issuance incentives in the private and public sectors.[38]

Finally, taken together, the analysis motivates an institutional design in which private actors supply a substantial share of liquidity in both markets in normal times, while the central bank retains a backstop role. In such a regime, the central bank preserves control of the nominal anchor through its reserve policy and remittances framework, and intervenes primarily when turbulence in private liquidity markets threatens an inefficient contraction in liquidity services. Operationally, the backstop can be implemented through temporary expansions of reserves and/or adjustments in administered rates, with the objective of stabilizing liquidity premia and maintaining price control without permanently crowding out private intermediation.[39]

5. THE ROLE OF TREASURY DEBT

In the baseline model, Treasury debt plays a limited role: it is assumed not to provide liquidity services, so it affects equilibrium only through the government budget constraints required for solvency. In particular, Treasury issuance does not enter the liquidity premium and therefore does not affect price dynamics directly.

In this section we relax this assumption and allow short-term Treasury debt held by the private sector to provide liquidity services. The motivation is that Treasury bills are widely used as high-quality collateral and settlement-like instruments, and therefore may deliver liquidity services similar to those of central bank deposits.[40] We proceed in two steps: first, we characterize how liquid Treasury debt modifies inflation dynamics; second, we discuss how it alters the nominal anchor and the implementation of optimal liquidity supply. We do this in the framework of Section 3 to highlight the main implications while abstracting from private liquidity competition.

Formally, we modify the liquidity-services term in household preferences by allowing Treasury debt held by the household to enter the same liquidity aggregate as reserves. That is, in the term $V(\cdot)$ we replace $q_t = X_t/P_t$ with

$$q_t \equiv \frac{X_t + B_t}{P_t}, \tag{40}$$

where B_t denotes one-period Treasury debt held by the household. Market clearing in the Treasury market implies $B_t = B_t^F - B_t^C$, so that open market operations that change B_t^C affect the quantity of liquid Treasury debt in private hands and therefore affect the liquidity premium.

To keep the interpretation of the Fisher equation unchanged, we continue to define i_t as the *market (illiquid) nominal rate* that prices intertemporal substitution, i.e. the rate that enters the Fisher relation via the household Euler equation. By contrast, i_t^x is the administered rate paid on central bank deposits (reserves). In what follows, we treat short-term Treasury debt that provides liquidity services as being remunerated at the same

[38]For classic analyses of why delegated monitoring and screening may be efficiently provided by intermediaries, see Diamond (1984) and Holmström and Tirole (1997). For a benchmark formulation of fiscal dominance forces, see Sargent and Wallace (1981).

[39]The "backstop" logic is closely related to the classic lender-of-last-resort principle; see Bagehot (1873).

[40]A large empirical literature documents that U.S. Treasury securities command sizable "convenience yields" consistent with liquidity and collateral services; see Krishnamurthy and Vissing-Jorgensen (2012) and Nagel (2016). For evidence and a policy-oriented interpretation emphasizing maturity and supply effects, see Greenwood, Hanson, and Stein (2015).

administered rate as reserves (or, equivalently, we assume arbitrage ties the Treasury bill yield to i_t^x).[41]

Combining the Fisher equation (19) with the reserve pricing condition (20), and using the modified definition of liquidity (40), yields

$$\frac{P_{t+1}}{P_t} = \beta \frac{1 + i_t^x}{1 - V_q\left(\frac{X_t + B_t}{P_t}\right)}. \tag{41}$$

Relative to (24), the novelty is that the liquidity premium now depends on the *total* stock of liquid, interest-bearing government liabilities held by the private sector, $(X_t + B_t)/P_t$, rather than on reserves alone.

Equation (41) implies that, away from satiation, variations in Treasury debt held by the private sector affect inflation dynamics by shifting the liquidity premium. In particular, an increase in B_t reduces the marginal liquidity value $V_q((X_t + B_t)/P_t)$, thereby compressing the liquidity premium and lowering the market rate i_t consistent with (20). Through the Fisher equation, this changes the equilibrium inflation rate. Therefore, when Treasury debt is liquid, the path of prices can no longer be insulated from fluctuations in Treasury debt held by the private sector unless the central bank offsets those fluctuations through reserve policy. A natural notion of "sterilization" in this setting is for the central bank to adjust X_t so as to stabilize the aggregate liquidity supply $(X_t + B_t)/P_t$.

Allowing Treasury debt to provide liquidity services does not eliminate the need for a nominal anchor: (41) remains a forward recursion for the price level. A convenient anchor continues to be given by the economy resource constraint together with a remittance policy that specifies a strictly positive stream of real transfers.

When Treasury bills are liquid and remunerated at i_t^x, the intertemporal resource constraint (23) is modified to:

$$\sum_{t=t_0}^{\infty} \beta^{t-t_0} \left(\frac{T_t^C}{P_t}\right) = \frac{\mathcal{W}_{t_0-1}^C}{P_{t_0}} + \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left(u_t^x \frac{X_t - B_t^C}{P_t} + u_t^m h_t\right),$$

where the initial nominal net worth is defined as:

$$\mathcal{W}_{t_0-1}^C \equiv (1 + i_{t_0-1}^x) B_{t_0-1}^C + (1 + i_{t_0-1}) D_{t_0-1} - (1 + i_{t_0-1}^x) X_{t_0-1} - (1 + i_{t_0-1}^m) M_{t_0-1}.$$

Accordingly, it is natural to modify the remittance rule so that it rebates the interest margin associated with private assets and includes a constant real component:

$$\frac{T_t^C}{P_t} = (1-\beta)\tau^C + i_{t-1} \frac{D_{t-1}^C}{P_t} - i_{t-1}^x \frac{X_{t-1}^C - B_{t-1}^C}{P_t} - i_{t-1}^m \frac{M_{t-1}^C}{P_t}, \tag{42}$$

The term $X_{t-1}^C - B_{t-1}^C$ is the quantity of reserves net of Treasury holdings on the asset side and therefore captures the portion of reserves that effectively finances private assets on the central bank balance sheet. Under (42), price-level determination proceeds exactly as in the baseline case, via (27), maintaining the same rationale. Given P_{t_0}, the subsequent price sequence is determined recursively by (41), subject to the regularity condition that the denominator in (41) remains positive. Moreover, this revised remittance rule is consistent with real net worth being determined exactly as in (29).

[41] Equivalently, one may introduce a separate yield i_t^B on liquid Treasury bills and impose $i_t^B = i_t^x$ in equilibrium. This section focuses on the economic implications of Treasury debt as a liquid instrument and abstracts from term premia and convenience-yield differentials across safe assets.

We next address the optimal supply of liquidity in this augmented framework. The results of Proposition 3 continue to hold, with the amendment that it is the *total* stock of interest-bearing liabilities —from both the Treasury and the central bank— that must exceed the satiation threshold $\bar{q}$:

$$\frac{X_t + B_t}{P_t} \geq \bar{q}.$$

As before, the remuneration of tokens must equal that of reserves ($i_t^m = i_t^x$) to achieve the satiation level of tokens.

In a first-best equilibrium with full satiation of both reserves and tokens, the following condition must hold:

$$\frac{X_t + B_t + M_t}{P_t} \geq \bar{q} + \bar{h}.$$

By utilizing the market clearing condition for Treasury debt ($B_t^C + B_t = B_t^F$) and the net worth condition (29), we can rewrite the inequality above as:

$$\frac{D_t^C + B_t^F}{P_t} \geq \bar{q} + \bar{h} + \beta\tau^C.$$

This result is striking. It demonstrates that under full satiation, liquidity provision relies on two potentially complementary factors: the central bank's holdings of private assets and the aggregate supply of Treasury debt.

To interpret this further, we invoke the Treasury's solvency constraint. In an equilibrium with full satiation, the value of Treasury debt is given by:

$$\frac{B_t^F}{P_t} = \beta \sum_{T=t}^{\infty} \beta^{T-t} \left(\frac{T_T}{P_T}\right) + \beta\tau^C.$$

Substituting this back into the liquidity condition yields:

$$\frac{D_t^C}{P_t} + \beta \sum_{T=t}^{\infty} \beta^{T-t} \left(\frac{T_T}{P_T}\right) \geq \bar{q} + \bar{h}.$$

This inequality implies that a sufficiently high present discounted value of primary surpluses is required to support the optimal liquidity provision. High future fiscal backing can complement the central bank's holdings of private bonds in satisfying the economy's demand for liquid assets. Conversely, if the Treasury does not supply sufficient liquidity (via debt backed by taxes), the burden falls entirely on the central bank to accumulate enough private assets to drive the overall supply of liquidity above the satiation threshold.

So far we have allowed Treasury debt to provide liquidity services while maintaining a monetary framework in which the Treasury plays a limited role in price determination. In practice, however, the institutional arrangement may grant the Treasury a more prominent role. The extreme case is one in which Treasury liabilities are not materially different from central bank reserves because they are (explicitly or implicitly) guaranteed by the central bank, directly or indirectly. This consolidated-government view lies at the core of the fiscal theory of the price level.[42]

Although central bank independence has received increasing attention, there are historical episodes and institutional arrangements in which the boundary between monetary and fiscal authorities is considerably less strict. In the extreme guarantee case, the key change relative to the analysis above is that the intertemporal constraint that provides the nominal anchor is no longer the intertemporal constraint (23), but instead the intertemporal constraint (22). The reason is that, under an explicit or implicit guarantee, the Treasury solvency constraint (14) no longer disciplines the valuation of Treasury debt: Treasury liabilities are backed by the monetary authority and are therefore valued as if they were safe central bank liabilities.

There are important implications for price determination. In particular, (22) now requires an appropriate tax policy to pin down the initial price level. We consider a simple specification in the spirit of the remittance rule used above.

Assumption 2. The Treasury follows a tax rule of the form

$$\frac{T_t}{P_t} = (1-\beta)\tau - (i_{t-1} - i^x_{t-1})\frac{B_{t-1} + X_{t-1}}{P_t}, \tag{43}$$

in which $\tau > 0$.

In the tax rule, there is a constant real component, captured by the positive parameter τ, and a second component that transfers to consumers the seigniorage revenues obtained from issuing liquid government liabilities at a lower cost, i^x, relative to the market rate i.[43] Substituting (43) into (22) for T, we obtain

$$P_{t_0} = \frac{(1 + i_{t_0-1})(B_{t_0-1} + X_{t_0-1})}{\tau}, \tag{44}$$

which determines the initial price level as proportional to the consolidated nominal liabilities of the government held by the private sector. We can also use the consolidated budget constraint of the government to obtain that, at each date, the real value of these liabilities is proportional to τ:

$$\frac{B_t + X_t}{P_t} = \beta\tau. \tag{45}$$

Since τ is proportional to the present discounted value of real taxes under the rule in Assumption 2, it can be interpreted as a reduced-form measure of fiscal capacity.

Equation (20) continues to hold, with the argument of $V_q(\cdot)$ now given by the consolidated net interest-bearing liabilities of the government held by the private sector, $(B_t + X_t)/P_t$. Combining this condition with the Fisher equation yields the inflation dynamics:

$$\frac{P_{t+1}}{P_t} = \beta\frac{(1 + i^x_t)}{1 - V_q\left(\frac{B_t + X_t}{P_t}\right)} = \beta\frac{(1 + i^x_t)}{1 - V_q(\beta\tau)}. \tag{46}$$

Both monetary and fiscal policies therefore play pivotal roles in determining inflation. Monetary policy

[42] See Leeper (1991), Sims (1994), Woodford (1995), and Cochrane (2023).

[43] For a related discussion of the fiscal consequences of remunerating reserves and the associated interest margin, see Bassetto and Messer (2013).

affects inflation directly through the administered interest rate on reserves, i_t^x. Fiscal policy affects inflation by governing the consolidated supply of real liquidity, $(B_t + X_t)/P_t$, and hence the liquidity premium embedded in $V_q(\cdot)$. To achieve the optimal supply of liquidity (when unconstrained), the Treasury should raise τ appropriately. Fiscal capacity becomes crucial in determining both the initial price level and the overall availability of real liquidity in the economy. Insufficient fiscal capacity, or constraints on the ability to adjust taxes, can lead to an inefficiently low supply of liquidity and can undermine price control.

Proposition 10 (Price level determination)**.** *Given the monetary policy specified in Assumption 1 and the fiscal policy in Assumption 2, assuming that the central bank fully guarantees Treasury debt, the sequence of prices $\{P_t\}_{t=t_0}^{\infty}$ is determined by (44) at time t_0 and recursively by (46) for all $t > t_0$, provided $1 - V_q(\beta\tau) > 0$.*

It is important to note that the central role of the Treasury in this regime is a direct consequence of the support it receives from the central bank. Under a full guarantee, price-level and inflation determination become a shared concern of monetary and fiscal policy. Ultimately, the choice of how much real liquidity to supply—and therefore the equilibrium price level consistent with that supply—depends on fiscal capacity.

Consider now the achievement of the optimal supply of liquidity $\bar{q}$. This requires that

$$\frac{B_t + X_t}{P_t} = \beta\tau \geq \bar{q}.$$

Therefore, it is the measure of fiscal capacity τ that determines whether the economy can be brought to the satiated region of the liquidity market. If τ is sufficiently large, the supply of liquid interest-bearing government liabilities is high enough to satiate liquidity demand.

It is again the case that token satiation requires the interest rate on tokens to be equal to that on reserves. Otherwise, away from satiation, the equilibrium quantity of tokens will be influenced by liquidity shocks, by the interest rate on reserves, and—novel in this regime—by fiscal capacity (because τ affects the consolidated liquidity premium and therefore the market rate).

Proposition 11 (Optimal supply of liquidity under the central bank's full guarantee of Treasury debt)**.** *Given the monetary policy specified in Assumption 1 and the fiscal policy in Assumption 2, assuming that the central bank fully guarantees Treasury debt, then a welfare-maximizing liquidity policy achieves satiation in both liquidity markets. In particular, it suffices that fiscal capacity is such that*

$$\tau \geq \frac{\bar{q}}{\beta} \quad \textit{for all } t \geq t_0,$$

and (ii) that monetary policy set the token remuneration rate equal to the reserve remuneration rate,

$$i_t^m = i_t^x \quad \textit{for all } t \geq t_0.$$

In equilibrium this implies $V_q(q_t) = 0$ and $L_h(h_t) = 0$, so the liquidity premia on both reserves and tokens are zero and $i_t = i_t^x = i_t^m$.

The extreme framework in which the central bank fully guarantees the Treasury therefore implies important modifications to inflation control and to the supply of liquidity. In this regime, overall fiscal capacity—captured by the parameter τ—becomes critical. If τ varies over time, it perturbs the liquidity premium and can become a source of imperfect price-level control from the perspective of the central bank. The central bank may then need to adjust the policy rate i^x to offset the inflationary or deflationary effects associated with changes in fiscal capacity, since reserves alone no longer serve as the unique margin for stabilizing the liquidity premium. Most importantly, the ultimate supply of liquidity is now a fiscal issue: an insufficient fiscal capacity may imply an insufficient supply of liquid government liabilities and, as a consequence, persistent liquidity premia.

Taken together, these sections connect the CBDC framework to the classic discussion in Friedman (1960) about the ultimate backing of government-provided liquidity. A useful way to read Friedman's argument in the present context is through two complementary channels. In one view, safe liquidity is effectively backed by the *asset side* of the monetary authority's balance sheet: the central bank issues liquid liabilities (reserves and, potentially, tokens) and supports them with sufficiently safe asset holdings, with remittances and balance-sheet policy providing the nominal anchor. This is precisely the logic emphasized in the first part of our analysis. In the other view, safe liquidity is ultimately backed by *fiscal capacity*: the value of nominal government liabilities rests on the present discounted value of future taxes (or primary surpluses), so fiscal capacity becomes central for price-level determination. This corresponds to the full-guarantee regime studied above, in which Treasury liabilities are treated as effectively equivalent to central bank liabilities.

In this sense, the model clarifies the institutional content of the question "who should supply liquidity?" When Treasury liabilities are fully backed by the monetary authority, liquidity provision and price determination are governed by the consolidated government balance sheet and hinge on fiscal capacity. Under that arrangement, monetary policy alone is not sufficient to guarantee both price control and liquidity satiation without a coherent fiscal backing of government liabilities.

Finally, the framework of this section could be enriched by allowing for the supply of private debt and tokens, as in Section 4. Doing so would refine the analysis at the margin, but it would not materially alter the main conclusions derived here.

6. CONCLUSION

This paper studies monetary policy in an environment in which central bank liabilities provide liquidity services and the monetary authority can set *administered* remuneration rates on these liabilities. The analysis highlights that, once reserves (and potentially tokens) yield administered returns, the relevant nominal rate in the Fisher equation is the *market* rate, which differs from the administered reserve rate whenever reserves deliver marginal liquidity services. As a consequence, inflation dynamics can depend not only on the administered rate i_t^x but also on the *quantity* of reserves, because reserve supply affects the equilibrium liquidity premium. The framework also clarifies how alternative institutional arrangements—from liquid Treasury debt, to a full central bank guarantee of Treasury liabilities, to privately supplied token-like instruments (stablecoins) and private money—shift the burden of liquidity provision and nominal anchoring across policy tools and balance sheets.

The model is intentionally simple in order to isolate these mechanisms. This simplicity is also the main limitation and shapes the scope of the interpretation.

First, the baseline environment is a flexible-price endowment economy. As a result, the model speaks directly to equilibrium inflation and price-level determination, but it is silent about the output and employment effects of monetary policy. In particular, the comparative statics that arise from changes in liquidity premia (e.g., reserve expansions lowering the market nominal rate) translate into movements in the price level rather than into real activity. In a New Keynesian environment with nominal rigidities, the same policy interventions would generally have short-run real effects, and the sign and timing of inflation responses could differ from the flexible-price benchmark. Therefore, the results here should be read as characterizing the *nominal* and *liquidity-premium* channels in isolation, not as a complete account of monetary transmission.

Second, the analysis is conducted under perfect foresight and abstracts from uncertainty. This rules out a number of empirically important features: state-contingent liquidity demand, flight-to-safety dynamics, run-like behavior, and endogenous risk premia. In practice, episodes of stress in token markets or in banking-sector liquidity provision are precisely environments in which uncertainty is central. A natural extension is to embed the same liquidity structure in a stochastic setting, allowing shocks to liquidity demand, intermediation technology, and asset payoffs. Doing so would permit an explicit characterization of risk-sensitive liquidity premia and would clarify how the central bank's joint control of (i_t^x, X_t) interacts with risk and expectations in determining inflation and the allocation of liquid claims.

Third, the private sector is modeled in a deliberately stylized way. Stablecoins are represented as demand-elastic token issuance backed by safe assets and subject to reduced-form frictions (captured by δ_{t+1}), and private money is represented as competitive intermediation with reduced-form wedges δ_{t+1}^a. This approach captures the main accounting and pricing implications transparently, but it abstracts from several key dimensions: maturity transformation, endogenous portfolio choice under risk, limited liability, equity issuance and capital regulation, collateral constraints, liquidity requirements, and run incentives. In richer environments, equity can itself provide part of the "backing" for privately issued liquid claims, and default and liquidity risk can make the effective returns on private money and stablecoins state contingent. These features would matter both for welfare and for the stability of private liquidity provision, and they would sharpen the policy trade-offs between reliance on private issuance in normal times and public backstops in crisis states.

Fourth, the nominal anchor is implemented through a convenient remittances rule. This choice is analytically useful, but it is not innocuous. In particular, the assumed remittances policy rebates portfolio earnings in a way that neutralizes a portfolio-income "seigniorage" channel that could otherwise contribute to backing and interact directly with price-level determination (see, e.g., (Benigno and Nisticò, 2025)). Allowing remittances to depend systematically on portfolio income and on the administered-rate structure would introduce a direct interaction between liquidity provision and the nominal anchor, because changes in liability issuance and in administered rates would translate into systematic movements in remittances and therefore into the valuation equation that pins down prices. We abstract from this interaction to keep the pricing mechanism transparent. If anything, incorporating portfolio-income backing would reinforce the paper's central message that balance-sheet policy and administered rates are jointly relevant for equilibrium liquidity premia and inflation dynamics.

Fifth, the framework abstracts from several institutional and empirical margins that are likely to matter for quantitative and policy conclusions: heterogeneous agents and payment needs, imperfect substitutability across liquid instruments, financial frictions affecting the supply of safe assets, deposit insurance and resolution regimes, and open-economy considerations (including currency substitution and cross-border stablecoin use).[44] Relaxing perfect substitutability would allow coexistence of multiple liquid instruments without knife-edge return equalization, and heterogeneity would permit distributional and inclusion questions that are central to current CBDC debates. Making safe-asset supply endogenous would also connect the analysis more tightly to fiscal capacity and to the determination of the stock of "backing" assets available to both public and private liquidity providers.

Despite these limitations, the simple structure delivers a clear set of organizing principles. Liquidity provision requires (i) a sufficiently safe *claim* and (ii) sufficient *backing*—whether through safe assets, through equity in richer private intermediation models, or through fiscal capacity when liabilities are consolidated with the Treasury. The special role of the central bank in the present framework is its ability to choose both the administered return and the quantity of reserves, thereby shaping the market rate that enters the Fisher equation and preserving a nominal anchor even when private token markets expand. Future work that enriches the model with nominal rigidities, uncertainty, endogenous risk, and a more detailed intermediary sector can build on these mechanisms to evaluate the welfare and stabilization trade-offs of CBDC design and stablecoin regulation in environments that more closely match observed monetary economies.

[44] Benigno (2025b) discusses the international dimension of the liquidity supply from the perspective of a dominant reserve currency.

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