On the Optimal Level of Stablecoins

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Abstract

This paper develops a general-equilibrium model to analyze the fiscal tradeoffs introduced by digital money (stablecoins). We find that stablecoins provide liquidity services that enhance transaction efficiency while simultaneously acting as a vehicle for sovereign debt demand; because stablecoins are backed by short-term government securities, they reduce sovereign borrowing costs and mitigate distortionary taxation, crowding in firm credit demand. Conversely, stablecoins may disintermediate the traditional banking sector, potentially elevating funding costs and contracting the credit supply necessary for real economic activity. Our model identifies an interior optimal level of stablecoins adoption. A calibration exercise suggests that optimal liquidity management—supported by $252–$358 billion in stablecoins—can increase output by 0.94% or welfare by 0.37%.

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1 Introduction

Stablecoins have recently attracted growing public and policy attention. Built on permissionless blockchains and enabled by distributed ledger technology (DLT) and smart contracts, stablecoins have the potential to significantly enhance payment efficiency, particularly in applications such as cross-border payments, trade finance, and cash management for multinational firms (Barr, 2025). In addition, as a widely accepted settlement asset within decentralized finance (DeFi), stablecoins allow users to access a broad range of financial services without relying on traditional intermediaries and potentially promote financial inclusion.

As a result, the stablecoins market has expanded rapidly in recent years, with a total market capitalization exceeding USD 300 billion in 2026. This magnitude is comparable to the total value of small-denomination U.S. dollar notes in circulation, which are primarily used as a means of payment.[1]

Despite the potential benefits, policy makers are concerned that stablecoins can reshape the financial system with unintended consequences. One frequently mentioned concern is that as a payment instrument, stablecoins may compete with retail deposits of commercial banks, raising banks' funding cost and hurting lending. Such a concern may or may not remain relevant in general equilibrium especially after the introduction of GENIUS act, which requires stablecoins to be backed by safe US-dollar denominated assets, e.g., short-term US government debt.[2] The fiscal aspects of digital money enters the debate, and they are urgently need to be studied.

This paper addresses this gap by proposing a dynamic general equilibrium model to analyze the long-run fiscal impacts of stablecoins. To isolate these effects, we abstract from the granular interactions between primary and secondary stablecoins markets.[3] In this framework, stablecoins and Central Bank Digital Currencies (CBDCs) function similarly as fiscal instruments. While CBDCs represent direct short-term liabilities of the consolidated fiscal-monetary authority, stablecoins—when backed by short-term government debt—exert downward pressure on yields by increasing demand for sovereign paper. Consequently, both forms of digital currency may generate significant seigniorage revenues for the consolidated government.

We consider five types of private agents, i.e., households, firms, commercial banks, a representative stablecoins issuer, and a government. Households need a medium-of-exchange for certain transactions, which can be retail deposits and the stablecoins. The stablecoins are issued by the

[1] See https://www.federalreserve.gov/paymentsystems/coin_data.htm#value.

[2] The predominant reserve asset of most stablecoins issuers is the treasury bill. For example, T-bills account for more than 60% of Tether's reserves, reverse repo agreement accounts for more than 10%, while deposits accounts only for less than 2%. See https://tether.to/en/transparency/?tab=reports. Therefore, outflow of retail deposits to stablecoins leads to reduction of bank deposits. But even if stablecoins issuers mainly hold bank deposits as reserves, the composition of deposits changes, i.e., more wholesale deposits and fewer retail deposits, leads to higher funding needs to satisfy regulatory requirements, e.g., liquidity coverage ratio requirement and net stable funding requirement, which may also reduce bank lending.

[3] See a recent work on limited arbitrageurs in the secondary market by Ma et. al (2025).

issuer and it needs to be backed 100% by short-term debt issued by the government. Firms have productive projects but need funding to pay for working capital. They can obtain the funds by borrowing from commercial banks, which issue retail deposits. Commercial banks can fund lending through retail deposits and debt, but lending is subjected to a profit constraint similar in spirit to Abadi et al. (2023). The government issues debt and levies distortionary tax on firms to finance spending.

Consistent with the concern of policy makers, the direct effect of the stablecoins is disintermediating commercial banks. Retail deposits are cheap relative to other funding sources because they facilitate transactions and command a liquidity premium, allowing banks to pay a lower interest rate. Competition from stablecoins generally lowers the quantity of retail deposits and increases the interest rates. This forces banks to rely more on other high-cost funding sources. This lowers lending by tightening the profit constraint.

Nevertheless, we identify a novel fiscal-monetary transmission mechanism that stimulates lending and the real economy, which we refer to as the fiscal "crowd-in" channel. As households substitute into stablecoins, the demand for short-term government liabilities by the stablecoins issuer rises. This lowers the government's effective financing costs, loosening the intertemporal budget constraint and allowing for a reduction in distortionary taxes. Lower tax rates, in turn, incentivize firms (facing financing constraints) to increase labor demand and credit demand, raising equilibrium output. We show that the fiscal "crowd-in" first dominates disintermediation and then is dominated as the stablecoins expand, a *stablecoins Laffer curve*. The aggregate effect of stablecoins depends on which effect dominates. Under certain parameters, lending and output first rise and then fall as the coin quantity increases. The aggregate welfare follows a similar pattern. This implies that there can be an optimal level of stablecoins issuance that balances various trade-offs.

In the quantitative part, we extend the model to incorporate the US banking features and P2P (peers-to-peers) stablecoins lending. Our quantitative analysis reveals that moderately integrating stablecoins into the financial ecosystem can catalyze significant macroeconomic expansion, yielding a potential 0.94% increase in steady-state output, equivalent to approximately $200 billion. While this growth necessitates a modest 1.73% contraction in traditional bank deposits due to crowding out, the broader liquidity pool actually expands by $241 billion. Most notably, we find that the gains extend beyond mere production; when accounting for reduced labor hours and increased consumption, social welfare is maximized at a 0.37% consumption equivalent increase, requiring $252 billion stablecoins. These results suggest that the efficiency gains of moderate stablecoin issuance substantially outweigh the slight displacement of traditional banking liabilities.

We further explore how market structure in the banking sector mediates these effects. We find that the fiscal stimulus provided by stablecoins is sensitive to the degree of banking competition. When the banking sector is more competitive (characterized by a higher number of banks, N), the introduction of stablecoins generates less economic stimulus. In a highly competitive environment,

banks operate with thinner profit margins; consequently, the crowding out of deposits precipitates a sharper contraction in lending activity, dampening the positive supply-side effects of the tax reduction.

Our findings further demonstrate that the efficacy of stablecoins is inextricably linked to the degree of banking competition, modeled as the number of banks in the Cournot competitions. In less competitive environments, stablecoins provide a vital corrective pressure that mitigates monopoly distortions; however, as the number of banks increases, compressed profit margins and high operational costs can lead to disintermediation and reduced lending. Interestingly, we find that more competition does not linearly improve outcomes. Instead, there exists an optimal policy mix, specifically at certain number of banks with stablecoin issuance at 1.68% of benchmark output, which achieves a maximum welfare gain of 1.71%. This suggests that while stablecoins are a powerful tool for enhancing market efficiency, their optimal deployment requires a calibrated banking landscape that balances competitive pressure with the structural costs of the banking sector.

Crucially, our model also provides a sobering reality check on the "fiscal savior" narrative often associated with digital money. During periods of severe fiscal strain, we find that a welfare-maximizing planner *does not* expand stablecoin issuance to generate seigniorage; instead, they aggressively retreat from digital liquidity to protect the commercial banking sector's productive credit capacity. Because stablecoins behave as an "economic luxury" constrained by real household wealth, the government cannot "print its way out" of deficits. Ultimately, our results suggest that while stablecoins are a powerful tool for enhancing market efficiency in stable times, they are not a magic "printing press" for fiscal crises, requiring a calibrated approach that balances digital innovation with the structural necessity of traditional bank lending.

In sum, by rigorously modeling the fiscal consequences of narrow bank liabilities, we provide new insights into how the optimal quantity of stablecoins, or digital currencies in general, depends not just on liquidity preferences, but also on the government's budget constraint and the industrial organization of the banking sector.

Related Literature. Our paper is closely related to the literature on the CBDCs. One stream of the CBDCs literature focuses on studying the effect of CBDCs on banking because policy makers are concerned that CBDCs can compete with bank deposits, raising banks' funding costs and reducing bank lending. That is why existing literature predominantly views CBDCs as a monetary policy tool, focusing on "monetary competition" between banks and digital money (e.g., Keister and Sanches, 2023). Whited et al. (2023), Li (2023), and Li et al. (2025) use an empirical IO approach and estimate the effect of a CBDC. While work on neutrality (Brunnermeier and Niepelt, 2019) and interest-rate competition (Andolfatto, 2021; Chiu et al., 2023) suggests possible lending expansion, these models largely abstract from the fiscal budget.

Another stream studies the implications of a CBDC on monetary policy. This includes Davoodalhosseini (2021), Barrdear and Kumhof (2021), Jiang and Zhu (2023), and Garratt et al. (2022). We

complement this literature by analyzing the implications of digital money on fiscal policy.

Thus, our analysis also relates to the literature on the optimal level of government debt and distortionary taxation. While Aiyagari and McGrattan (1998) determine the optimum quantity of debt by balancing its insurance value against the costs of distortionary taxes, we focus on the novel role of debt as a backing asset for digital liquidity. This perspective connects to the "deposits channel" identified by Drechsler et al. (2017), where banks utilize monopoly distortions to extract liquidity premiums from depositors. While Drechsler et al. (2021) emphasize how deposit outflows contract bank balance sheets, we find that stablecoins can mitigate these distortions by introducing competitive pressure. Unlike these studies, we identify a fiscal "crowd-in" channel where stablecoin seigniorage allows for tax cuts that stimulate labor and credit demand, potentially offsetting the effects of bank disintermediation. Note that by providing an alternative to traditional bank liabilities, stablecoins or CBDCs trigger a funding substitution effect similar to the shift between retail deposits and market-based funding documented by Chen et al. (2026) in the Chinese banking context.

While Burlon et al. (2024) identify a "fiscal expansion effect," disintermediation remains the dominant lending outcome in their framework. Conversely, while Barrdear and Kumhof (2021) find consumption increases through seigniorage recycling, they abstract from the granular banking competition and arbitrage costs in stablecoins needed to identify the threshold where fiscal gains transition into systemic risk. Williamson (2022)'s normative analysis focuses on balancing disintermediation and collateral efficiency of CBDC. This paper models seigniorage recycling from issuance of digital money into distortionary tax cuts to actively "crowd-in" credit demand and bank lending while strategically containing wealth to protect the tax base.

This paper is also related to the literature on fiscal and monetary policy interaction; more specifically, our framework contributes to the fiscal aspects in money-search frameworks pioneered by Kiyotaki and Wright (1993), Trejos and Wright (1994), Lagos and Wright (2005), and Rocheteau and Wright (2013). This literature focuses mainly on passive fiscal policy and studies steady states or belief driven dynamics. Recently, Gu et al. (2025) compare dynamics in the model of Lagos and Wright (2005) when the fiscal policy leads and when the monetary policy leads. Our framework highlights the key fiscal-monetary interaction with frictional banking sector and seigniorage revenues from modern digital currencies. The optimal stablecoins level and banking frictions thus extend the findings of optimal financial distortions in Bassetto and Cui (2024).

2 Model

Time is discrete and continues from zero to infinity. There are five types of agents: a measure-two continuum of households with buyers and sellers, a measure-one continuum of firms, a finite number of N banks, a representative stablecoins issuer, and a consolidated government of monetary

and fiscal authorities. We first present the model without aggregate shocks, and discuss the version with aggregate shocks in the quantitative section.

In each period t, agents interact sequentially in two stages: a frictional decentralized market (DM) and a Walrasian centralized market (CM). There are two perishable goods: y in the DM and c in the CM. Firms and banks rebate profits equally to all households. Stablecoins are digital tokens or electronic entries that can be used for retail payments in both markets. The representative issuer issues stablecoins backed by short-term government liability. The fiscal authority sets tax policy and transfer policy and issues nominal long-term and short-term bonds. The monetary authority targets a "shadow" short-term nominal interest rate. The consolidated government uses tax income and receipt from newly issued bonds to pay for exogenous real government spending G_t, matured bonds, and transfers.

In the DM, we assume that deposits and coins, if valued, are substitutes in terms of payment functions. In the quantitative exercise later, stablecoins have an additional person-to-person lending function thanks to the features of smart contracts in practice. For now, we assume that banks cannot hold stablecoins. Moreover, the number of banks, N, is fixed, and banks engage in Cournot competition in the deposit market, while the lending market is perfectly competitive. These two modeling choices simplify the algebra, but relaxing these assumptions can strength the fiscal trade-offs we will highlight in the paper.

2.1 The Households

Households are divided into two permanent types, buyers and sellers, each with unit measure. In the DM, a buyer randomly meets a seller. The meeting probability is $\alpha \in (0, 1]$ for both buyers and sellers. The buyer wants to consume y, which is produced by the seller. The buyer's utility from consumption is $u(y)$ with $u'(0) = \infty$, $u' > 0$, and $u'' < 0$. The seller's disutility from production is normalized to y. Households lack commitment and cannot enforce debt repayment. As a result, the DM trade must be quid pro quo, and buyers must use a means of payment to exchange for y. We will discuss available means of payment later and the terms of trade. In the CM, both buyers and sellers can work with a disutility of h units of hours and consume c. The utility from consumption in the CM is $U(c)$ with $U'(0) = \infty$, $U' > 0$, and $U'' < 0$.

For convenience, we work out the problem in CM and then the problem in DM proceeding the CM. In the CM of period t, a buyer chooses the quantities of deposits m_t^d and coins m_t^e brought into the next period. They do not hold short-term government bonds, as the interest rate on short-term bonds are lower than the long-term ones while short-term bonds do not provide liquidity service as stablecoins and deposits.

CM Denote the long-term bond price as q_t^b, the gross deposit rate as R_t^d, and the gross interest rate for coins as R_t^e. Let the nominal price level be P_t. We follow Woodford (2001), in which a unit of long-term debt (with unit face value) at time t pays ρ^k dollars in any period $t+k+1$ going forward $\forall k \geq 0$, where $0 \leq \rho < 1/\beta$. In the steady state, the duration of long-term debt is given by $(1-\beta\rho)^{-1}$.

Let $W_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right)$ be the value of a household with m_{t-1}^d deposits, m_{t-1}^e coins, and b_{t-1} bonds in the CM of period t. The discount factor from the current period to the next is $\beta \in (0,1)$. The buyer's CM problem is written as

$$\begin{aligned} W_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) = & \max_{\{c_t, m_t^e, m_t^d, b_t\}} U\left(c_t\right) - h_t + \beta V_{t+1}\left(m_t^d, m_t^e, b_t\right) \\ & \text{st. } c_t + \frac{m_t^d + m_t^e + q_t^b b_t}{P_t} \\ & = w_t h_t + \frac{R_{t-1}^d m_{t-1}^d + R_{t-1}^e m_{t-1}^e + (1+\rho q_t^b) b_{t-1}}{P_t} + \Delta_t^B + \Delta_t^F + \gamma_t, \quad (1) \end{aligned}$$

where w_t is the real wage, γ_t is real lump-sum transfer, and Δ_t^B and Δ_t^F are the (nominal) dividends from banks and firms, respectively. The first-order conditions imply

$$\begin{aligned} \left[m_t^e\right] : \frac{1}{P_t w_t} &\geq \beta \frac{\partial V_{t+1}\left(m_t^d, m_t^e, b_t\right)}{\partial m_t^d} \\ \left[m_t^d\right] : \frac{1}{P_t w_t} &\geq \beta \frac{\partial V_{t+1}\left(m_t^d, m_t^e, b_t\right)}{\partial m_t^e} \\ \left[b_t\right] : \frac{q_t^b}{P_t w_t} &\geq \beta \frac{\partial V_{t+1}\left(m_t^d, m_t^e, b_t\right)}{\partial b_t} \\ \left[c_t\right] : U'\left(c_t\right) &= \frac{1}{w_t}. \end{aligned}$$

The inequalities hold as equalities if the holding of corresponding assets are positive. The optimizing outcome (proposition below) turns out to be rather simple, which is a direct consequence of the quasi-linear utility feature, where hours h enters utility linearly. It is common in the new-monetarist literature, and the benefit is that we do not have to keep track of assets distribution. Moreover, in the real business cycle (RBC) literature, a linear utility in hours is commonly seen (e.g., in Hansen 1987 and Rogerson 1988). Recently, Cui, Wright, and Zhu (2025) extend this framework to study capital reallocation and show it can match the US data well.

Formally, we have the following result

Proposition 1. *Everyone consumes the same amount where the consumption level solves*

$$c_t = \left(U'\right)^{-1}\left(w_t^{-1}\right), \quad (2)$$

and the portfolio choice of deposits, stablecoins, and bonds is identical. The value function $W_t(m^d, m^e, b)$ *has the slopes represented by*

$$\frac{\partial W_t(m^d, m^e, b)}{\partial m^d} = \frac{R^d_{t-1}}{P_t w_t}, \frac{\partial W_t(m^d, m^e, b)}{\partial m^e} = \frac{R^e_{t-1}}{P_t w_t}, \frac{\partial W_t(m^d, m^e, b)}{\partial b} = \frac{1+\rho q^b_t}{P_t w_t}.$$

Notice that the sellers' labor supply and consumption decisions are the same as buyers', but do not hold coins and deposits because they do not need to consume in the DM. Therefore, we omit sellers' problem but would like to point out the slopes of the seller's CM value function are the same as the buyer's CM value function.

DM Let $V_t\left(m^d_{t-1}, m^e_{t-1}, b_{t-1}\right)$ be the value of a buyer with deposits m^d_{t-1}, coins m^e_{t-1}, and bonds b_{t-1} in the DM of period t. With probability α, the household meets a counterparty and uses some or all of the deposits $\tilde{m}^d_{t-1}$ and coins $\tilde{m}^e_{t-1}$ to purchase goods y_t. The DM value function is thus

$$\begin{aligned} V_t\left(m^d_{t-1}, m^e_{t-1}, b_{t-1}\right) =& \alpha\left[u\left(y_t\right) + W_t\left(m^d_{t-1} - \tilde{m}^d_{t-1}, m^e_{t-1} - \tilde{m}^e_{t-1}, b_{t-1}\right)\right] \\ &+ \left(1-\alpha\right) W_t\left(m^d_{t-1}, m^e_{t-1}, b_{t-1}\right), \end{aligned}$$

where the terms of trade $\left(y_t, \tilde{m}^d_{t-1}, \tilde{m}^e_{t-1}\right)$ are determined by bargaining between the buyer and seller in the meeting. In the bargaining problem, the surplus of the buyer can be expressed as

$$\begin{aligned} S^b(y_t, \tilde{m}^d_{t-1}, \tilde{m}^e_{t-1}) &\equiv u\left(y_t\right) + W_t\left(m^d_{t-1} - \tilde{m}^d_{t-1}, m^e_{t-1} - \tilde{m}^e_{t-1}, b_{t-1}\right) - W_t\left(m^d_{t-1}, m^e_{t-1}, b_{t-1}\right) \\ &= u\left(y_t\right) - \frac{R^d_{t-1}\tilde{m}^d_{t-1}}{P_t w_t} - \frac{R^e_{t-1}\tilde{m}^e_{t-1}}{P_t w_t}. \end{aligned}$$

The last equality follows because W_t is linear in m^d_{t-1} and m^e_{t-1} with slopes specified in Proposition 1. Similarly, we can write the surplus of the seller as

$$S^s(y_t, \tilde{m}^d_{t-1}, \tilde{m}^e_{t-1}) = \frac{R^d_{t-1}\tilde{m}^d_{t-1}}{P_t w_t} + \frac{R^e_{t-1}\tilde{m}^e_{t-1}}{P_t w_t} - y_t,$$

Note that y_t is the seller's production cost and the first two terms are the seller's CM value of deposits and coins received from the buyer. Notice here we use the slopes of the seller's CM value are the same as those of the buyer.

We assume Kalai bargaining for tractability reasons, where the buyer's bargaining power is θ. This bargaining problem is equivalent to choosing y_t and real balance $\tilde{z} = \frac{R^d_{t-1}\tilde{m}^d_{t-1} + R^e_{t-1}\tilde{m}^e_{t-1}}{P_t}$ spent by the buyer. Here, we use a take-it-or-leave-it offer by the buyer, i.e., $\theta = 1$. The Appendix has the general solution to the bargaining problem, and it does not change the qualitative results. The bargaining power is not essential for the results of fiscal tradeoffs. Because $\tilde{z}/w_t$ is the continuation value of real balances for both the buyer and the seller, $\frac{\tilde{z}}{w_t} = y_t$. Let y^* be the socially efficient

DM consumption, which solves $u'(y^*) = 1$, as the marginal cost of the seller is unity. Given the constraint of liquidity, the solution becomes $y = Y(z; w)$ and $\tilde{z} = \min\{z, z_t^*\}$ such that

$$Y(z; w_t) \equiv \begin{cases} \frac{z}{w_t} & \text{if } z < z_t^* \\ y^* & \text{if } z \geq z_t^* \end{cases}$$

where we define $z_t^* \equiv w_t y^*$. It means that when liquidity is abundant, consumption will reach the unconstrained level y^*; when liquidity is insufficient, consumption will be constrained by the level of liquidity, z/w_t.

With the bargaining solution, we can express the value function in DM as

$$\begin{aligned} V_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) =& \alpha\left[u\left(Y\left(\frac{R_{t-1}^d m_{t-1}^d + R_{t-1}^e m_{t-1}^e}{P_t}; w_t\right)\right)\right. \\ & \left. - \min\left\{\frac{R_{t-1}^d m_{t-1}^d + R_{t-1}^e m_{t-1}^e}{w_t P_t}, \frac{z^*}{w_t}\right\}\right] + W_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right). \end{aligned}$$

Then, using the previous result of CM value function, we know the marginal values of deposits, coins, and government bonds in DM are

$$\begin{aligned} \frac{\partial V_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right)}{\partial m_{t-1}^d} &= \left\{\alpha\lambda\left(\frac{R_{t-1}^d m_{t-1}^d + R_{t-1}^e m_{t-1}^e}{P_t}; w_t\right) + 1\right\}\frac{R_{t-1}^d}{P_t w_t} \\ \frac{\partial V_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right)}{\partial m_{t-1}^e} &= \left\{\alpha\lambda\left(\frac{R_{t-1}^d m_{t-1}^d + R_{t-1}^e m_{t-1}^e}{P_t}; w_t\right) + 1\right\}\frac{R_{t-1}^e}{P_t w_t} \\ \frac{\partial V_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right)}{\partial b_{t-1}} &= \frac{1 + \rho q_t}{P_t w_t} \end{aligned}$$

where $\lambda(.;.)$ reflects liquidity premium and the function is defined as

$$\lambda_t(z) = \lambda(z; w_t) \equiv u'(Y(z; w_t)) - 1.$$

Notice that when $z \geq z_t^*$, there is no extra liquidity service so that $\lambda(z) = 0$.

Combining CM and DM We are almost ready to derive the portfolio choice of deposits, coins, and bonds for buyers. A seller, on the other hand, solves a similar problem except that she produces in the DM. Therefore, she does not hold coins or deposits, while she could save in government bonds. Let X be the aggregate variables of x, then aggregate deposit $M_t^d = m_t^d$ and aggregate coins $M_t^e = m_t^e$. Let the gross inflation be $\Pi_t = P_t/P_{t-1}$ and define the real values of deposit and coins as

$$Z_t^d \equiv \frac{M_t^d}{P_t}, \quad Z_t^e \equiv \frac{M_t^e}{P_t}$$

Now, the Euler equations for deposits, coins, and bonds become

$$U'(c_t) \geq \beta U'(c_{t+1}) \left[\alpha \lambda_{t+1} \left(\frac{R_t^d Z_t^d + R_t^e Z_t^e}{\Pi_{t+1}} \right) + 1 \right] \frac{R_t^d}{\Pi_{t+1}}, \tag{3}$$

$$U'(c_t) \geq \beta U'(c_{t+1}) \left[\alpha \lambda_{t+1} \left(\frac{R_t^d Z_t^d + R_t^e Z_t^e}{\Pi_{t+1}} \right) + 1 \right] \frac{R_t^e}{\Pi_{t+1}}, \tag{4}$$

$$U'(c_t) \geq \beta U'(c_{t+1}) \frac{R_t^b}{\Pi_{t+1}}, \tag{5}$$

with strictly inequality if the corresponding quantity chosen is zero. For consistency, (5) uses a nominal holding-period rate of return, the shadow short-term interest rate, of long-term debt

$$R_t^b \equiv \frac{1 + \rho q_{t+1}^b}{q_t^b}$$

(3)-(5) illustrate the role of liquidity. For deposits and coins, the liquidity aspect is reflected by the probability α of meeting and the marginal gain represented by $\lambda_{t+1}(\cdot)$.

The Euler equations implicitly define nominal deposit rate R^d as a function of deposit quantity given other variables. We focus on the case in which households are constrained in the DM, which implies that $\alpha \lambda_{t+1} \left(\frac{R_t^d m_t^d + R_t^e m_t^e}{P_{t+1}} \right) + 1 > 1$. Therefore, households are willing to hold bonds only if $R_t^b > R_t^e$ and $R_t^b > R_t^d$. One can show that the Euler equation of a seller is the same as (5). Aggregate bond holding of the households is $B_t^h = 2 \int b_t(i) di = 2 b_t$ where $i \in [0, 1]$ denotes agent i in the buyer group.

2.2 Firms and Banks

Firms operate for one period and rebate all the profits back to households when they are old. Both firms and households lack commitment and cannot enforce debt repayment, so no direct credit arrangement among them is viable. Therefore, firms cannot postpone the payment of wages until production process is completed. Instead, they need to borrow funding to pay the wage bills.

Like firms, new banks are established in the CM, become old and replaced by new banks in the next CM. Unlike households and firms, banks can commit to repay their liabilities and enforce the repayment of debt from firms. Therefore, banks act as intermediaries between households and firms to finance investment projects. A bank can finance its loans by issuing deposits, which can be used as a medium of exchange to facilitate trading between buyers and sellers in the DM. It can invest in loans and long-term government bonds.[4] Banks are subject to a profit constraint that loans cannot exceed a fraction χ of its expected profit. This constraint can be interpreted as a capital requirement in the sense that the expected profit can be regarded as the equity held by the

[4] As will become clear, banks do not hold short-term government bonds/stable coins as the return is lower than the long-term government bonds, and they also do not use coins for transaction purposes.

owners of the bank.

Firms Firms borrow from the banks and hire labor $\hat{h}_t$ in time t. This yields output $(1-\tau_t)Af\left(\hat{h}_t\right)$ in time $t+1$, where A is aggregate productivity and τ_t is the tax rate. Because firms do not have resource, they need to finance wage payments using loans. To hire $\hat{h}_t$ labor, a firm needs to borrow $P_t w_t \hat{h}_t$, with a nominal repayment of $R_t^l P_t w_t \hat{h}_t$ next period. This working-capital type of financing constraints is common in the literature. As a result, a representative firm at time t maximizes the real discounted profit by choosing labor hours $\hat{h}_t$.

$$\max_{\hat{h}_t} \beta \left[(1-\tau_t) Af\left(\hat{h}_t\right) - \frac{R_t^l w_t P_t \hat{h}_t}{P_{t+1}} \right].$$

Notice that the specific discount factor used does not have real influence on the firm's choice as it is taken as given by the firm. Since there is one unit measure of firms, we can directly use the aggregate variable in the first-order condition

$$(1-\tau_t) Af'\left(\hat{H}_t\right) - \frac{R_t^l w_t}{\Pi_{t+1}} = 0. \tag{6}$$

The firms' problem also yields loan demand, since wages are all financed by loans ($w_t \hat{H}_t P_t$) we have the real value of loans L_t^r as

$$L_t^r = w_t \hat{H}_t. \tag{7}$$

Finally, the period-t realized profit per capita is thus given by

$$\Delta_t^F = \frac{1}{2} \left[(1-\tau_t) Af\left(\hat{H}_t\right) - \frac{R_{t-1}^l w_{t-1} P_{t-1} \hat{H}_t}{P_t} \right].$$

Banks Banks engage in Cournot competition in the deposit market and perfect competition in the loan market. It is also possible to incorporate competition in the loan market. To simplify, we only consider competition in the deposit market as it is more relevant for policy that influences coins. Therefore, the loan rate R_t^l is taken as given, and it is competitive. Note that the Cournot setup simplifies the analysis; we also analyzed a version with monopolistic competitions, but the key insight of imperfect competition does not change.

The major issue a bank considers is the demand for deposits. Let $\hat{\mathbf{R}}_t\left(M^d; M^e\right)$ be the *inverse demand function* for nominal deposits, which implies the deposit rate given total deposit M^d and coins M^e influenced by policy. This inverse demand function can be backed out from the household's problem, and it is taken as given by all banks. After knowing the inverse deposit demand function, a typical bank solves the following problem by maximizing the expected real discounted

profit

$$\begin{aligned}
&\max_{\{\hat{l},\hat{b},\hat{m}\}} \frac{\beta\Delta_t^B}{P_{t+1}} \\
&\text{s.t. } \Delta_t^B \equiv R_t^l\hat{l} + R_t^b\hat{b} - \hat{m}\hat{\mathbf{R}}_t\left(\hat{m} + \tilde{M}_t^d; M_t^e\right) \\
&\quad \hat{m} = \hat{l} + \hat{b} \\
&\quad \hat{l} \leq \chi\Delta_t^B, \qquad (8)
\end{aligned}$$

where $\tilde{M}_t^d$ is the total deposit supply of all other banks. The last constraint states that the loan quantity cannot exceed a fraction of expected profit. One can interpret this constraint as a capital requirement specified by Basel III regulation. A high enough χ in practice can help the bank pay costs, cover bad loans, and leave enough profit to grow capital. While Basel III does not mandate a specific profit margin, a large enough χ is structurally necessary to generate the organic retained earnings required to maintain stringent Common Equity Tier 1 (CET1) ratios as the bank's assets grow. Without this specific level of profitability, the bank would be unable to replenish its capital buffer, eventually leading to a breach of Basel capital adequacy requirements. In fact, it is straightforward to extend the analysis with bank equity in an infinite-horizon problem. At least the steady state will look similar as the profits are used to grow equity. Notice that the only variable that influences the real profit, P_{t+1}, is taken as given, and thus the problem is equivalent to maximizing the nominal profit.

We solve the bank's problem in two steps. Given $\hat{m}$, we compute the loan supply. We focus on the case that $\chi\left(R_t^l - R_t^b\right) < 1$. If $R_t^l > R_t^b$, the bank lends until the constraint (8) becomes binding. Then, using the optimality condition for deposit $\hat{m}$ and impose symmetry assumption for simplicity, we can have the following characterization of the total deposit quantity M_t^d resulting from the Cournot competition among banks (see Appendix for details):

$$R_t^d = \hat{\mathbf{R}}_t\left(M_t^d; M_t^e\right) = R_t^b - \frac{M_t^d}{N}\hat{\mathbf{R}}_t'\left(M_t^d; M_t^e\right)$$

where by the implicit function theorem $\hat{\mathbf{R}}_t'\left(M_t^d; M_t^e\right)$ is obtained from the household inverse demand function. That is, the deposit rate is a *mark-down* of the implied short-term (holding-period) rate R_t^b. Intuitively, because the constraint (8) is binding, any additional funding raised from deposits have to be invested in bonds. Therefore, a bank's marginal benefit of deposits is R_t^b and it can pay less to depositors because of market power. We focus on the interesting case where the profit constraint is binding, which requires $R_t^l > R_t^b$.

It is more convenient to work with real values. We define the inverse demand function with real liquidity as the argument $\tilde{\mathbf{R}}_t\left(M_t^d/P_t; M_t^e/P_t\right) = \hat{\mathbf{R}}_t\left(M_t^d; M_t^e\right)$, both generating R_t^d in equilibrium. Then, we have

Proposition 2. *The deposit rate is a mark-down of the bond rate*

$$R_t^d = R_t^b - \frac{Z_t^d}{N}\tilde{\mathbf{R}}_t'\left(Z_t^d; Z_t^e\right), \tag{9}$$

where $\tilde{\mathbf{R}}_t'$ is obtained by implicit function theorem using the household's first-order condition for deposits.

Proof. See the Appendix. □

Finally, real loans from the banking sector are thus given by

$$\hat{L}_t^r = \chi Z_t^d \frac{R_t^b - R_t^d}{1 - \chi R_t^l + \chi R_t^b}, \tag{10}$$

The real profit from all N banks in per-capita term is given by $\Delta_t^B = M_{t-1}^d \frac{R_{t-1}^b - R_{t-1}^d}{2P_t\left(1-\chi R_{t-1}^l + \chi R_{t-1}^b\right)}$.

Stablecoins Issuers For financial institutions that issue stablecoins, we consider their business as competitive *narrow banking* to simplify the analysis. Namely, a representative issuer will back every coin issued using short-term government debt as the assets. In this sense, the coins used by households are indirectly controlled by short-term debt policy. Since the level of M_t^e will be the same as that of short-term government bonds, we economize notation by simply using M_t^e for short-term bonds. The interest rates on the coins and the short-term government debt are the same in equilibrium.

2.3 Government Policy and Equilibrium

The government is a consolidated entity of the fiscal and the monetary authorities. The consolidated government's budget equation in real terms is represented by

$$G_t + \frac{R_{t-1}^e Z_{t-1}^e + R_{t-1}^b B_{t-1}^r}{\Pi_t} + T_t = Z_t^e + B_t^r + \tau_t A f(H_t), \tag{11}$$

where $B_t^r = q_t^b B_t / P_t$ is the real long-term debt. On the left is the spending including expenditures G_t and transfers $T_t = 2\gamma_t$, as well as repayments of previous debt. On the right is the source of revenues from new issuance of debt and tax income. The fiscal policy consists of setting G_t, T_t, τ_t, B_t^r, and Z_t^e. One can consider the stablecoins policy as a *quantity cap on issuance* specified by Z_t^e. The monetary policy targets the shadow interest rate R_t^b (then, influencing the price of long-term bonds).

Now, we are ready to define equilibrium. As mentioned previously, we focus on the interesting equilibrium in which $Af\left(k\right)$ is sufficiently high such that in the steady state the loan rate is higher

than the bond rate.

Definition. Given exogenous government policy (τ_t, Z_t^e, B_t^r, G_t, T_t) and state variables (Z_{t-1}^d, Z_{t-1}^e, B_{t-1}^r, L_{t-1}^r, H_{t-1}, R_{t-1}^l, R_{t-1}^d, R_{t-1}^e), a recursive competitive equilibrium with stablecoins is a sequence of aggregate variables $\{C_t, Z_t^d, H_t, L_t^r\}$ and prices $\{q_t^b, R_t^e, R_t^d, R_t^l, w_t, \Pi_t\}$ for $t \geq 0$, such that

- consumption is given by (2), and optimal portfolio choices satisfy (3)-(4);
- firms solve the labor and loan choices which satisfy (6) and (7);
- banks optimize in the deposit market so that (9) holds. The amount of loans is given by (10);
- the government budget constraint holds (11);
- market clearing conditions are summarized by goods market clearing $C_t + G_t = Af(H_{t-1})$ where $C_t = 2c_t$, labor market clearing $\hat{H}_t = H_t$, and loan market clearing $\hat{L}_t^r = L_t^r$.

Note that the portfolio choices already use money market clearing: $M_t^d = m_t^d$ and $M_t^e = m_t^e$. Also, one can verify the aggregate household budget constraint because of Walras's law:

$$C_t + \frac{M_t^e}{P_t} + \frac{M_t^d}{P_t} = R_{t-1}^e \frac{M_{t-1}^e}{P_t} + R_{t-1}^d \frac{M_{t-1}^d}{P_t} + w_t H_t + 2T_t + 2\Delta_t^B + 2\Delta_t^F. \tag{12}$$

3 Analytical Results

We analyze the theoretical property behind the steady state with inflation level $\Pi = 1$ (in fact, this is a cash-less limit). We fix spending G, transfers $T = 0$, real-long term debt B^r. Since our main focus is the circulation of stablecoins, we will vary Z^e and let the tax rate τ to adjust in the steady state. This approach illustrates the fiscal trade-offs and the macroeconomic impacts, so we can answer if there is an optimal level of stablecoins.

For analytical purpose, we assume $u(x) = \ln x$ (this is also consistent with a balanced growth path), so that $\lambda(x; w) = w/x - 1$ and $\lambda'(x; w) = -w/x^2$. Also, production function is $Af(x) = Ax$ with $A > 0$.

3.1 Demand and Supply for Deposits

In this part, we determine the deposits demand and supply, and thus the deposit rate that clears the market. Notice that from the first-order condition for bonds $R^b = 1/\beta$, and the first-order condition for deposits:

$$R^d = \frac{1}{\beta}\left[\alpha\left(\frac{w}{R^d\left(Z^d + \xi Z^e\right)} - 1\right) + 1\right]^{-1}$$

where $\xi = R^e/R^d$. Recall that $Z^d = M^d/P$ and $Z^e = M^e/P$ are the real level of deposits and coins. In the benchmark economy, the returns R^d and R^e are the same (they deposits and coins provide the same level of liquidity) so that $\xi = 1$. When later we introduce P2P lending, stablecoins will have a different return and $\xi > 1$. For notation consistency, we leave ξ there. The above generates an inverse demand function for (real) deposit, linking the deposit rate and the level of deposit.

$$R^d = \frac{1}{\beta(1-\alpha)} - \frac{\alpha w}{(1-\alpha)(Z^d + \xi Z^e)} \tag{13}$$

From the bank's profit condition, we have

$$R^d = \frac{1}{\beta} - \frac{\alpha}{N(1-\alpha)} \left[\frac{Z^d/w}{(Z^d/w + \xi Z^e/w)^2} \right] \tag{14}$$

We transform variables so that $\tilde{Z}^d = Z^d/w$, $\hat{Z}^e = \xi Z^e/w$, and $\tilde{Z} = \tilde{Z}^d + \hat{Z}^e$. These are normalized (relative to the real wage) deposit liquidity, coins liquidity, and total liquidity. After using the inverse demand function (13) above, substituting out R^d in (14), we have a quadratic equation in total liquidity $\tilde{Z}$

$$\tilde{Z}^2 - \beta \left(\frac{N-1}{N} \right) \tilde{Z} - \beta \frac{\hat{Z}^e}{N} = 0$$

It turns out to be easier to regard temporarily $\hat{Z}^e$ as exogenous, and then we solve for $\tilde{Z}$ and other equilibrium objects. Then, we can back out the truly exogenous level Z^e. When $\hat{Z}^e = 0$, we have $\tilde{Z}^d = \tilde{Z} = \beta\left(\frac{N-1}{N}\right)$; When $\hat{Z}^e \neq 0$, we have $\tilde{Z} > \tilde{Z}^d > 0$ (assuming $\hat{Z}^e > 0$) should take the positive root

$$\tilde{Z} = \frac{\beta\left(\frac{N-1}{N}\right) + \sqrt{\beta^2\left(\frac{N-1}{N}\right)^2 + 4\beta\frac{\hat{Z}^e}{N}}}{2} \tag{15}$$

and $\tilde{Z}^d = \tilde{Z} - \hat{Z}^e = \frac{\beta\left(\frac{N-1}{N}\right) + \sqrt{\beta^2\left(\frac{N-1}{N}\right)^2 + 4\beta\frac{\hat{Z}^e}{N}}}{2} - \hat{Z}^e$. After solving for $\tilde{Z}$, the deposit liquidity is $\tilde{Z}^d = \tilde{Z} - \hat{Z}^e$. Naturally, with perfect competition, $N \to \infty$, we have $\tilde{Z} = \beta$ and $\tilde{Z}^d = \beta - \hat{Z}^e$. Finally, given $\hat{Z}^e$ and $\tilde{Z}^d$, the real deposit rate can be computed from (14).

Proposition 3. *In the steady state with $\Pi = 1$, a rise of $\hat{Z}^e$ in equilibrium increases the deposit rate R^d. When $N \to \infty$, R^d converges to the benchmark rate β^{-1}.*

3.2 Impacts of Stablecoins Issuance

Given a normalized coin liquidity $\hat{Z}^e$, we have so far obtained normalized total liquidity $\tilde{Z}$ and normalized total deposit liquidity $\tilde{Z}^d$, as well as the deposit rate. The coin's rate or short-term government bond rate can be calculated from the Euler equation (4) in the steady state. Notice that we already obtained that the interest rate on government debt is $1/\beta$. Then, we are ready to assess

the effect on the banking competition and the macroeconomy.

As mentioned before, we fix the long-term debt supply. The short-term debt (or coins) policy thus influences the coins and the tax rate τ. Essentially, we gradually increase coins policy variable Z^e from zero and assess the impact on the economy. From the goods market clearing

$$2\left(U'\right)^{-1}\left(\frac{H}{L}\right)+G=2w+G=AH$$

so that hours can be expressed as $H=(2w+G)/A$. From the bank's budget constraint, we have

$$H\left(\frac{1}{\chi}-R^l+\frac{1}{\beta}\right)=\tilde{Z}^d\left(\frac{1}{\beta}-R^d\right)\equiv J(\hat{Z}^e),$$

where according to previous analysis the right-hand side is only a function of $\hat{Z}^e$ because $\tilde{Z}^d$ and the deposit rate R^d are functions of $\hat{Z}^e$. Then, using the bank's budget constraint to eliminate H in the goods market clearing condition, we can uniquely solve for w from a quadratic equation in the wage rate w with only one positive root.

Lemma 4. *Assume $u(x)=\ln x$ and $f(x)=Ax$. The steady-state equilibrium wage rate can be expressed as*

$$w=\frac{AJ(\hat{Z}^e)+2A(1-\tau)-G\Gamma+\sqrt{\left[AJ(\hat{Z}^e)+2A(1-\tau)-G\Gamma\right]^2+8\Gamma GA(1-\tau)}}{4\Gamma}$$

where $\Gamma\equiv 1/\chi+1/\beta$.

Proof. See the Appendix. □

Finally, let's look at the government budget constraint to determine the tax rate. After substitutions, we obtain the steady state version of (11)

$$(1/\beta-1)\,B^r=\tau\,(2w+G)-G-S(\hat{Z}^e)w$$

where

$$S(\hat{Z}^e)\equiv\hat{Z}^e\left[R^d\left(\hat{Z}^e\right)-1\right].$$

In other words, τ solves the government budget constraint.

To further simplify, suppose $G=0$, then $w=\left[J(\hat{Z}^e)+2A\,(1-\tau)\right]/(2\Gamma)$, we have the government budget constraint as

$$\tau^2-\left[\frac{S(\hat{Z}^e)}{2}+\frac{J(\hat{Z}^e)}{2A}+1\right]\tau+\frac{S(\hat{Z}^e)}{2}\left[\frac{J(\hat{Z}^e)}{2A}+1\right]+\frac{(1/\beta-1)\,\Gamma}{2A}B^r=0 \tag{16}$$

Therefore, depending on the debt and coins policy, τ may or may not have two roots. To see this, the left-hand side is a quadratic function of the tax rate τ, opening upward with a symmetric line being $\tau = 0.5\left[\frac{S(\hat{Z}^e)}{2} + \frac{J(\hat{Z}^e)}{2A} + 1\right]$. At least for small $\hat{Z}^e$, the symmetric line is positive and the intercept is positive. So, there must be two positive roots. If the symmetric line is negative then there is one single root.

Proposition 5. *Suppose $G = 0$, β and A are sufficiently large. Then steady-state equilibrium tax rate $\tau \in (0, 1)$ exists. When there are multiple (two) roots of τ, the equilibrium should feature the lower tax rate one, denoted as $\tau(\hat{Z}^e)$, for a given level of coins provision $\hat{Z}^e$. Moreover, if N is not too big, there exists a positive level of coins provision that minimizes the tax rate $\tau(\hat{Z}^e)$.*

Proof. See the Appendix. □

Intuitively, when productivity is high enough and B^r is not too large, or the banking competition is not too severe (small N), an equilibrium exists. The tax rate has a minimizer. The issuance of stablecoins (backed by short-term debt) provides seigniorage revenues, as the interest rate is below $1/\beta$ thanks to the liquidity premium. The seigniorage revenues can be large enough and reduce the need to tax the economy. However, more issuance implies a higher interest rate and it crowds out the banking activities, so the tax rate eventually goes up. Note that output or even CM output may or may not be maximized at the same level of $\hat{Z}^e$, which can be seen in later numerical exercises.

This result is the core for the interaction between fiscal policy and the digital financial system. Stablecoins (or CBDCs) compete with commercial banks, but its effect on fiscal budget could potentially make the tax burden smaller. Whether digital currencies have crowding in or crowding out effects depends heavily on banking competitions and the structure of the economy. Notice that, at this stage, the wage rate w and other macro variables are calculated in a straightforward way. Then, the real value of short-term bonds or stablecoins is $Z^e = w\hat{Z}^e/\xi$, which could be regarded as the true policy variable. We choose to use numerical exercises to illustrate the relationship of macro variables of interests with the level of truly exogenous level of coins provision Z^e.

4 Quantitative Analysis

This section provides quantification of the channels discussed above. We ask the question what is the output/welfare maximizing provision of stablecoins in the steady state.

4.1 Extension with Digital Meetings, P2P Lending, and Banking Costs

To make the model more realistic, we introduce an important feature of stablecoins without modifying the environment significantly. Beyond serving as a reliable medium of exchange, stablecoins

are integrated into decentralized finance ecosystems, enabling peer-to-peer (P2P) lending (DeFi Lending) without traditional intermediaries. We therefore allows a special digital meeting, occurring with a probability α^e, in which only the coins can be used for transactions. This modeling is realistic given that coins can be used to purchase other digital assets

In addition, through smart contracts, users in the digital meetings can lend or borrow coins directly, earning interest or accessing liquidity in a transparent and borderless way. We model this feature following Berentsen et al. (2007). Specifically, after the CM closes and before the DM opens, suppose some information is revealed that affects agents' desire to hold coins. Let this information simply be whether each agent will have a digital meeting in the next DM. Those that will not have a digital meeting hold excess coins; those that will have a meeting could use more.

This liquidity mismatch creates a role for the coins issuers, as in Diamond and Dybvig (1982), except here they deal in coins not goods. What makes the issuers essential is that agents cannot easily trade liquidity among themselves using promised CM repayment, for the same reason they cannot trade DM goods using promised CM repayment: lack of commitment and lack of concern for reputation. If issuers have reputation concerns, making their promises credible, plus a comparative advantage in collecting debt, they have a role intermediating the reallocation of liquidity (see Gu et al. 2023 for a survey of banking models with these features).

While not crucial for the theory, the P2P lending aid in the quantitative effects of fiscal tradeoffs since they prop up coins demand. The insight in Berentsen et al. (2007) is that the ability to retrade liquidity makes it less costly, since if you find yourself with more than you need you can keep it in the bank, at interest, financed by loans to those who want more (another instance of secondary markets affecting demand in primary markets).[5]

We set the utility function of using stablecoins as close as possible to DM utility,

$$u^e(x) = \log(\zeta + x) - \log \zeta$$

so that $\lambda^e(x; w) = (u^e)'(x)/w - 1$ and $\lambda^e_t(x) = (u^e)'(x)/w_t - 1$. Because of the parameter ζ, the utility form does not change the baseline when the level of stablecoins is zero. As a result, the above modification changes the Euler equation for coins to

$$U'(c_t) \geq \beta U'(c_{t+1}) \left[\alpha \lambda_{t+1} \left(\frac{R^d_t Z^d_t + R^e_t Z^e_t}{\Pi_{t+1}} \right) + (1-\alpha) \lambda^e_{t+1} \left(\frac{R^e_t (1-\alpha) Z^e / \alpha^e}{\Pi_{t+1}} \right) + 1 \right] \frac{R^e_t}{\Pi_{t+1}},$$

Like deposits, the liquidity aspect is reflected by the probability α of meeting and the marginal gain represented by $\lambda(\cdot)$. The extra digital meeting and P2P lending possibility affect the Euler equation in two ways. First, $(1-\alpha)Z^e_t/\alpha_1$ enters the liquidity premium λ^e_{t+1} instead of Z^e_t. Notice

[5]Berentsen et al. (2007) show if this lending market is perfectly competitive, the gross loan rate is equal to the marginal utility from liquidity for those who have consumption opportunities. Buyers enjoy the liquidity value of the stablecoins regardless whether they have consumption opportunities.

Table 1: Calibration (no coins)

β	N	χ	Π	A	H	G	α	κ
0.97	19	28.57	1	0.4879	1.82	0.192	0.3506	0.0011
bond rate	rate spread	regulation	exo	B^r/Y	tax rate	G/Y	dep rate	bank cost
3%	5%	3.48% NIM	–	1.0	0.25	0.192	0%	2% GDP

that total $(1-\alpha)Z_t^e$ of coins are brought into the digital meetings. Second, buyers anticipate that they can borrow using P2P lending to increase their stablecoins holding when needed, so we divide the amount by α_1 for each buyer. In sum, the digital meetings and P2P lending raise the liquidity value of stablecoins. More details are provided in the appendix.

Finally, we introduce the cost of banking since stablecoins compete with banking sector, and the competition among banks is also a key ingredient. Simply, each bank requires a fixed operating cost of κ,so in total the banking sector eats κN units of goods paid by the households. In this sense, the profits rebated back by the banking sector are now adjusted down by κN.

4.2 Calibration

We calibrate the steady-state model to the US economy in 2020, when stablecoins such as USDT and USDC were just started to be backed by US dollar assets. So, in this economy, $Z^e = 0$. We normalize $B^r = 1$ and set the key parameters as in Table 1 and gross inflation $\Pi = 1$. Note that inflation in 2020 was about 1%. Calibrating Π to a different level (1-1.03) does not change the qualitative result we have below, and the quantitative difference is negligible as well.

The interest rate on government debt is targeted at 3%, roughly the interest payments over all government debt in 2020. The (real) deposit rate is set to be 0%, which pins down α. Note that this parameter controls the degree of liquidity needs. The number of banks determines banking competition and thus influences the spread between the loan rate R^l and deposit rate R^d, which is set to be 5%. A spread of 5%, meaning the loan rate is 5%, is reasonable, as the model does not distinguish different types of loans for simplicity. As a reference, average Baa bond yield in 2019-2020 is 4.3% and average high yield is 6.4%. These are market rates, and loan rates are typically higher for similar maturity and similar risks. We target the debt to GDP ratio as 100%, the same as that of the beginning of 2020. Government spending over GDP is set to 19.2%, similar to the data.

The parameter χ is set to 28.57, so the net interest margin (NIM) coverage as fraction of assets is 3.48%. This number is only 18 basis points above the average at the end of 2019 according to Federal Deposit Insurance Corporation (FDIC) and the St. Louis Federal Reserve (FRED). The small out-performance is not driven by credit risk expansion, but by a better cost of funds and, more importantly, a disciplined Asset-Liability management strategy compliant with Basel III that the model should capture. Therefore, results below will be more conservative.

We calibrate κ such that the total operating costs of the banking sector is 2%. Calibrating the fixed operating costs of the banking sector to 2% of GDP is a robust assumption for the US economy, as it is triangulated by both asset-based and income-based empirical metrics. From a balance sheet perspective, total commercial banking assets in the US generally hover around 85% to 90% of GDP, and banks historically report noninterest expenses—such as payroll, IT infrastructure, and physical branches—at approximately 2.4% of those total assets, which inherently yields a macroeconomic footprint of just over 2%. Note that this number aligns with the income statement approach: while the commercial banking slice generates roughly 3.5% to 4.0% of GDP in total revenue, US banks operate with an efficiency ratio of around 58%. Because noninterest expenses consume about 58% of that revenue, the structural overhead naturally converges to that exact same 2% of GDP threshold. Ultimately, our calibration of banking costs reflects the real-world resource drain required to maintain the banking network.

The efficient labor unit H is calibrated such that we have the tax rate of 25% on total output as in the data. Given the quasi-linear utility, we can also introduce another parameter of disutility of labor supply, and set the true labor supply to be 1/4 or 1/3 in a conventional macro model calibration. This strategy does not make a difference as long as the product is the same as H.

Finally, while not targeted, the model generated M1-output ratio is about 32%, slightly higher than 30% from the 2020 flow-of-funds account. M1 here excludes savings deposits (despite the change of classification in 2020).

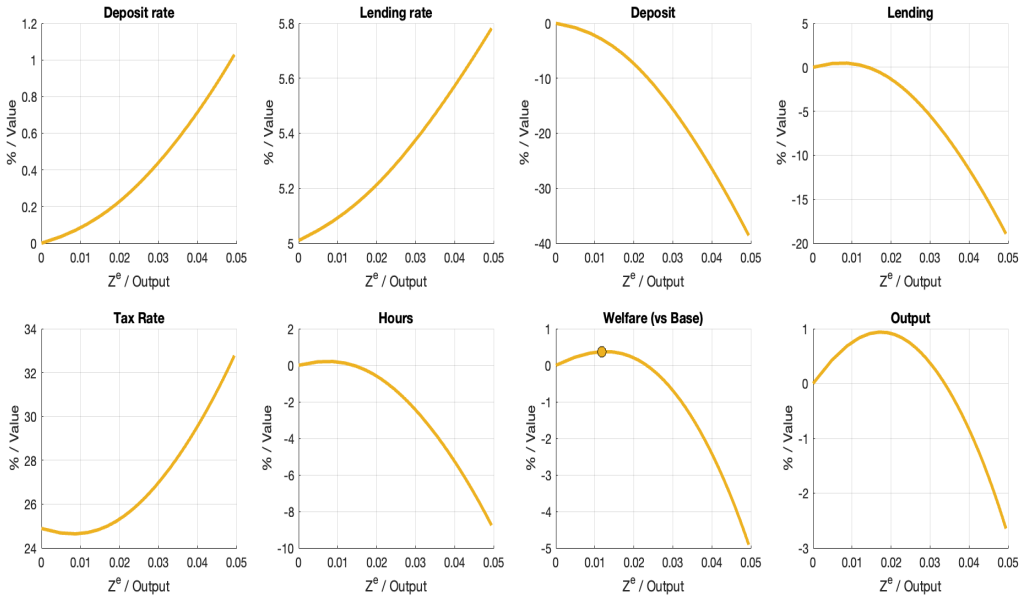
Digital Meetings All of the parameters above determine the steady state without stablecoins. When we introduce stablecoins, we then need to calibrate α_1 and ζ.

We set $\alpha_1 = 0.05$, assuming that 5% of all economic meetings strictly require a digital currency (Z_e) because traditional bank deposits (Z_d) face prohibitive technological or economic frictions. This 5% target is derived from two distinct structural inefficiencies in the traditional banking system, each accounting for roughly half of the targeted probability space.

First, traditional cross-border payments and remittances rely on the correspondent banking network (e.g., SWIFT), which requires pre-funded Nostro/Vostro accounts, multi-day settlement delays, and average fees of 3% to 6%. Given that U.S. international trade and cross-border flows equate to over 25% of U.S. GDP, conservatively assuming that just one-tenth of these flows (roughly 2.5% of total economic transaction demand) require the instantaneous, 24/7 finality of stablecoins provides the first half of the calibration.

Second, the remaining 2.5% is driven by programmable B2B settlements. Domestic B2B volume vastly exceeds U.S. GDP, yet traditional deposit rails (like ACH or wire transfers) cannot quickly execute conditional logic or “atomic" settlement (Delivery-versus-Payment). As modern supply chains increasingly require funds to be released via smart contracts simultaneously with digital verification of goods, or rely on machine-to-machine micro-transactions where standard in-

Figure 1: The macroeconomic impacts of stablecoins



Note: Deposit, lending, and tax rates are simply their numerical levels. Others are deviation from the benchmark, with welfare being consumption equivalent changes from the calibrated base level.

terchange fees are unviable, this programmable subset easily accounts for the remaining 2.5% of the transaction space. Combined, these two factors justify a 5% baseline probability for meetings that operate exclusively outside the traditional deposit system.

The smoothing parameter ζ is calibrated to 0.5 to ensure that the specialized liquidity provided by stablecoins carries a shadow price to justify the weighted average of costs in the high-friction segments of the U.S. payments market, specifically the 6% fees associated with retail cross-border remittances and the implicit liquidity costs of settlement delays in B2B supply chains.

4.3 Optimal Provision of Stablecoins

The quantitative exercise gradually introduces stablecoins (backed by short-term debt). The introduction of coins provides seigniorage revenues, thanks to the demand for short-term debt with low interest rate R_t^e, leading to a fall of tax rate. Because of the competition, deposits are crowded out. However, lending is not crowded out for low level of stablecoins thanks to the lending rate that is rising faster than the deposit rate. That lending rate can rise faster is also a consequence of the falling tax rate.

As stablecoins continue to rise, the seigniorage revenues eventually fall, generating a higher tax rate (Figure 1). But the minimizing level for tax rate is different from the maximizing level for lending, and also it is different from the maximizing level for output (which includes both CM and DM output).

Output thus can be maximized with a 0.94% gain of steady-state output ($21.35 trillion in 2020), about $200.7 billion. This requires stablecoins issuance to be 1.68% of steady-state output ($358.7 billion), crowding out deposits by 1.73%, roughly 0.55% of steady-state output (note: recall that deposits are about 32% of output in the calibration). Total liquidity including both deposits and stablecoins increases by the amount of 1.13% of steady-state output, about $241.3 billion. In summary, the benefits of issuing stablecoins are significant, achievable at the expense of crowding out slightly banking deposits.

The consumption response almost mimics that of output. Therefore, welfare is maximized, with a consumption equivalent increase of 0.37%, at slightly lower circulation of stable coins (about $251.9 billion), since hours of work are lower than the level when output is maximized.

4.4 The Role of Banking Competitions

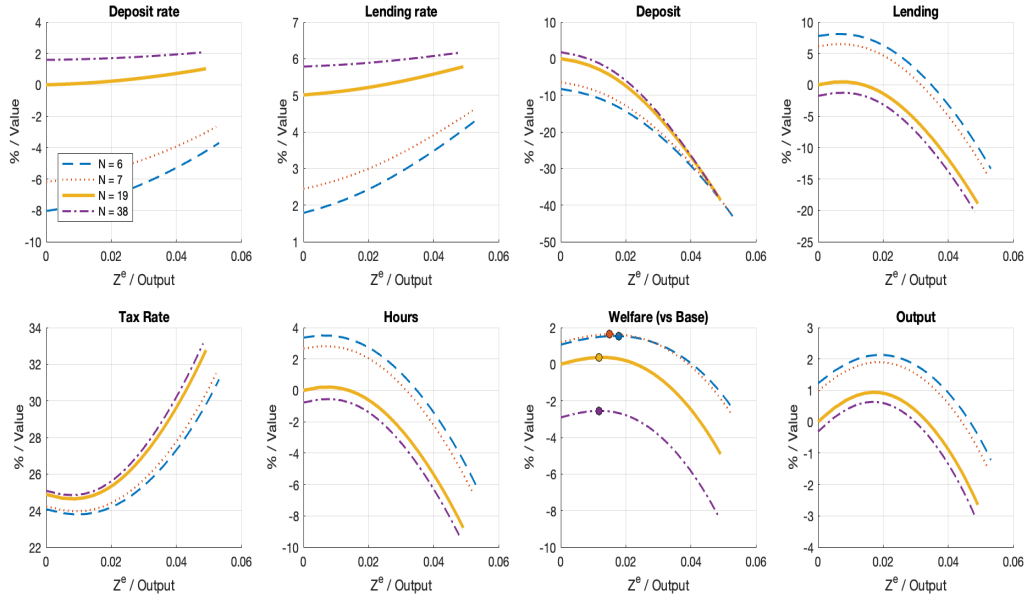
Banking competition, which is central to efficiency, plays a key role in determining the effects of stablecoins issuance. We first consider economies without stablecoins. As banking competition increases, modeled by raising N from 19 to 38, deposit creation rises slightly in equilibrium, since banks must offer higher deposit rates for any given level of stablecoins (the solid line and the dash-dotted line of Figure 2). At the same time, lending declines because higher competition compresses bank profits. Quantitatively, the deposit rate increases by about 180 basis points, while the lending rate rises by 85 basis points, squeezing margins and reducing lending. As a result, output must fall.

The impact of stablecoins is deeply contingent on the existing degree of banking competition. Their stimulative effects diminish in more competitive systems, resulting in lower lending and output for any given level of stablecoins issuance. Essentially, output declines as banking competition increases because compressed profit margins inevitably restrict lending activities. Consequently, disintermediation is most severe when competition is already intense. To maximize output, a theoretical "monopoly bank" model—which minimizes fixed costs—would maximize lending capacity. In this scenario, stablecoins serve as a critical competitive pressure to mitigate the monopoly's distortion of the deposit market. This is illustrated by the fact that output peaks at similar levels of stablecoins issuance whether $N = 19$ or $N = 38$. Since $N = 19$ already provides significant competitive pressure, the marginal amount of stablecoins required to further reduce monopoly power remains relatively constant.

If we exclude banking costs (κ), increased competition improves allocative efficiency; raising N from 19 to 38 increases welfare by approximately 0.1% in consumption-equivalent terms, even as output falls. Conversely, reducing N from 19 to 9 triggers a 0.52% welfare drop. However, once the operational (or regulatory) costs of banking are factored in, welfare declines sharply as the number of banks grows.

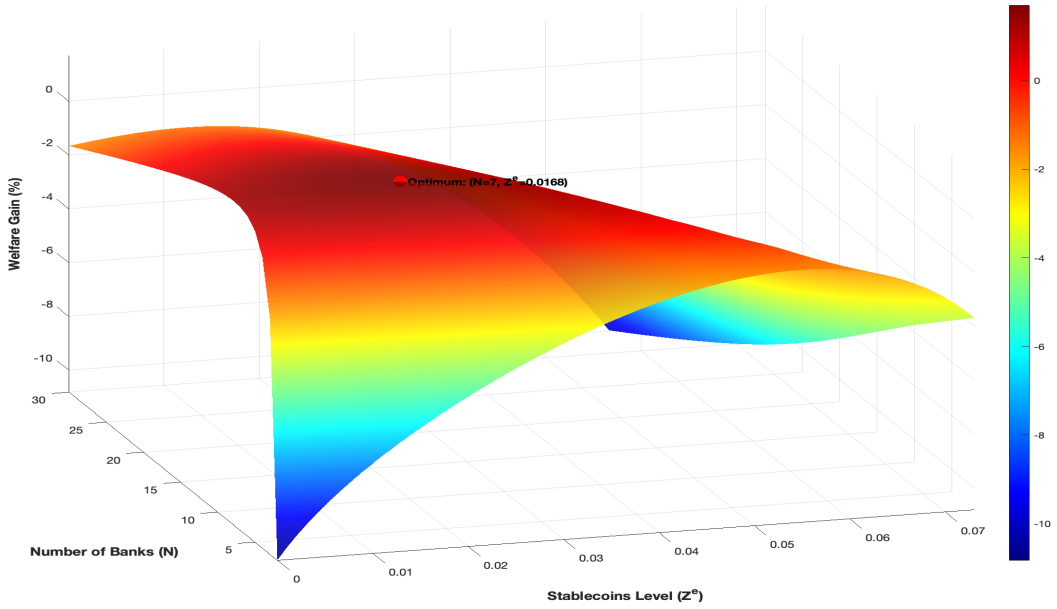
Overall, these results suggest that there could exist an optimal pair of (N, Z^e). If we consider

Figure 2: Stablecoins and banking competition



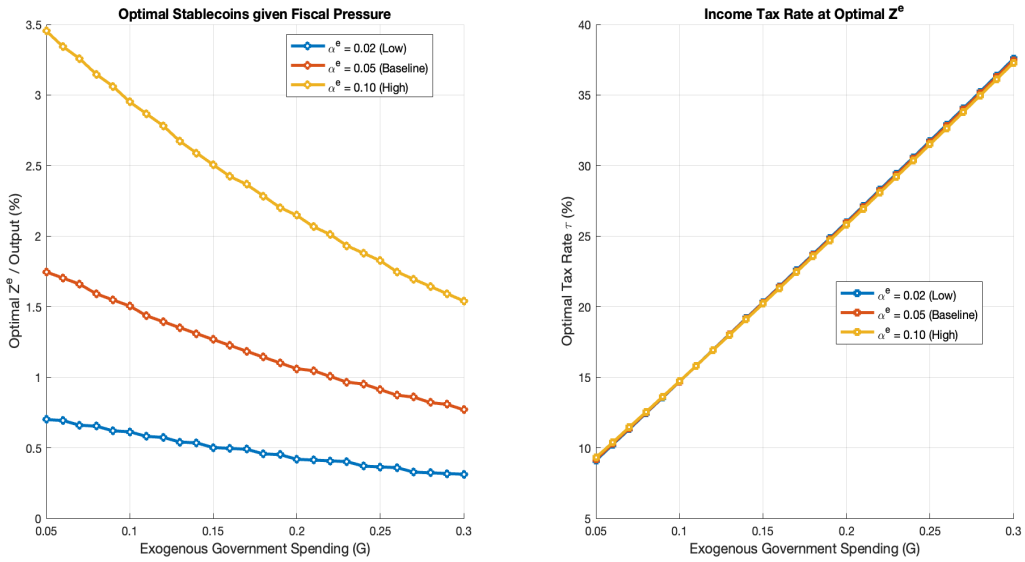
Note: Deposit, lending, and tax rates are simply their numerical levels. Others are deviation from the benchmark, with welfare being consumption equivalent changes from the calibrated base level.

Figure 3: Optimal stablecoins and banking competition



Note: Welfare is calculated as consumption equivalent changes from the calibrated base level.

Figure 4: Optimal stablecoins and tax levels



banking policy as setting the number of N (or influencing the banking cost), then a proper mix of N and Z^e can achieve the best outcome. Ultimately, Figure 3 shows that welfare is maximized at $N = 7$ when stablecoins issuance is maintained at approximately 1.68% of benchmark output, about $358.7 billion. At this level, we can increase the welfare by 1.71%, measured as the consumption-equivalent unit in the benchmark. Still, note that the welfare difference is not large for $N \in (5, 15)$, as long as the right amount of stablecoins are used.

4.5 Limits of Stablecoins Policy for Fiscal Pressure

To understand the optimal monetary-fiscal policy mix during periods of severe fiscal strain, we introduce an exogenous permanent shock to government spending (G). A common hypothesis with digital currency is that central banks might optimally issue digital currency (Z^e) to generate seigniorage revenue, thereby avoiding politically costly and economically distortionary income tax hikes. We map the welfare-maximizing stablecoins to the corresponding optimal income tax rate (τ) as government spending increases from 5% to 30% of total output. We test this across three scenarios representing low, baseline, and high household preference for stablecoins liquidity (α^e). The results reveal a stark macroeconomic reality: optimal digital currency issuance does not scale to meet fiscal pressure. Instead, the optimal policy planner aggressively retreats from stablecoins and relies almost entirely on distortionary taxation (Figure 4).

"Luxury" Digital Liquidity and Collapse of the Seigniorage Tax Base As shown in the left panel, the optimal stablecoins strictly declines as government spending increases. While a higher

innate preference for digital currency (α^e) uniformly shifts the optimal supply curve upward, the negative slope remains robust, and it actually steepens under high demand. This dynamic is driven by the marginal utility of physical consumption. As the government absorbs a larger share of the economy's output, household consumption is heavily crowded out. In response, the marginal utility of physical goods skyrockets. While the stablecoins provide a liquidity and convenience benefit to the household, this convenience behaves as an economic "luxury." When the household is starved of physical consumption, the welfare-maximizing planner optimally reduces the stablecoins (or short-term debt) supply to minimize any disintermediation in the commercial banking sector. By protecting bank deposits, the planner maximizes private credit allocation, labor, and output, prioritizing basic economic survival over digital liquidity.

The right panel dismantles the hypothesis that digital-currency seigniorage can seamlessly fund fiscal expansions. Regardless of how much the household prefers digital currency, the optimal income tax rate rises linearly and uniformly to bear the fiscal burden. The government cannot print its way out of a fiscal shock using stablecoins because the seigniorage tax base is inherently constrained by the real economy. Seigniorage revenue is proportional to total stablecoins balances, which are constrained by household wealth and wages. As high government spending crowds out the real economy, private wages fall. The household simply does not possess enough wealth to hold the massive digital currency balances that would be required to generate meaningful seigniorage. Consequently, the government has no alternative but to aggressively hike the income tax rate (τ) to balance the budget.

A closer inspection of the tax paths reveals a subtle but vital structural trade-off: a higher preference for stablecoins (or digital money) actually requires a slightly higher optimal tax rate. Because issuing highly-demanded stablecoins backed by short-term government debt partially crowds out commercial bank deposits, it marginally shrinks the real productive capacity of the economy. This shrinks the government's real income tax base. To raise the same amount of revenue for G from a slightly smaller real economy, the government is forced to impose a marginally higher tax rate.

Ultimately, the model shows that digital currencies are not a "magic printing press" for fiscal deficits. Because aggressive stablecoins issuance relies on a wealthy private sector to hold the balances, and because it inherently competes with productive commercial bank credit, a welfare-maximizing government must abandon digital seigniorage and revert to traditional taxation during periods of extreme fiscal pressure.

5 Conclusion

This paper empahsizes a fundamental trade-off introduced by stablecoins. As in previoius work, while they enhance transaction efficiency and generate government seigniorage, they can also disintermediate traditional banks. When backed by government debt, however, stablecoins create a

fiscal "crowd-in" effect: rising demand for sovereign paper lowers borrowing costs, allowing for distortionary tax cuts that stimulate labor and output.

Our quantitative analysis identifies an interior optimal level for stablecoins, approximately $374–$483 billion. At this peak, fiscal benefits and liquidity gains outweigh bank displacement, potentially increasing output by 1.75% or welfare by 2.77%. This “sweet spot" is sensitive to market structure; in highly competitive banking sectors with thin margins, the contraction in lending from disintermediation is more severe.

Ultimately, stablecoins are not a “fiscal savior" during crises. Because they behave as an “economic luxury" constrained by household wealth, a welfare-maximizing planner must retreat from digital liquidity during severe fiscal strain to protect the banking sector’s productive credit capacity. Optimal deployment requires a balance between digital innovation, banking competition, and the government’s budget constraint.

References

[1] Abadi, J., M. Brunnermeier, and Y. Koby (2023) “The reversal interest rate." American Economic Review 113, no. 8 (2023): 2084-2120.

[2] Andolfatto, D. (2021) “Assessing the Impact of Central Bank Digital Currency on Private Banks.” *The Economic Journal*, available at https://doi.org/10.1093/ej/ueaa073

[3] Aiyagari, S. R., and McGrattan, E. R. (1998). "The optimum quantity of debt." *Journal of Monetary Economics*, 42(3), 447–469.

[4] Barr, M. S. (2025) “Exploring the possibilities and risks of new payment technologies [Speech].” Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/newsevents/speech/barr20251016a.htm

[5] Barrdear, J., and M. Kumhof (2021) “The Macroeconomics of Central Bank Issued Digital Currencies.” *Journal of Economic Dynamics and Control*, 104-148,

[6] Bassetto, M., and W. Cui (2024). A Ramsey theory of financial distortions. Journal of Political Economy, 132(8), 2612-2654.

[7] Berentsen, A., G. Camera, and C. Waller (2007) “Money, Credit and Banking.” *Journal of Economic Theory*, 135(1), 171-195.

[8] Brunnermeier, M. and D. Niepelt (2019) “On the Equivalence between Private and Public Money.” *Journal of Monetary Economics* 106(C), 27-41.

[9] Burlon, L., M. A. Muñoz, and F. Smets (2024). “The optimal quantity of CBDC in a bank-based economy. " *American Economic Journal: Macroeconomics*, 16(4), 172-217.

[10] Chen, K., Y. Xiao, and T. Zha (2026). “A Trade-off Between Monetary Policy Transmission and Systemic Risk." Working Paper.

[11] Choi, M., and G. Rocheteau (2021). “Money mining and price dynamics." *American Economic Journal: Macroeconomics*, 13(4), 246-294.

[12] Cui, W., R. Wright, and Y. Zhu (2025) “Endogenous liquidity and capital reallocation.” *Journal of Political Economy* 133(1), 146-189.

[13] Davoodalhosseini, M. (2021) “Central Bank Digital Currency and Monetary Policy,” *Journal of Economic Dynamics and Control*, 104-150

[14] Drechsler, I., Savov, A., and Schnabl, P. (2017). “The Deposits Channel of Monetary Policy.” *Quarterly Journal of Economics*, 132(4), 1819–1876.

[15] Dreschler, I., A. Savov, and P. Schnabl (2021) “Banking on Deposits: Maturity Transformation without Interest Rate Risk.” *Journal of Finance* 76(3), 1091-1143.

[16] Gu, C., R. Wright and Y. Zhu (2025) “Some New Monetarist Arithmetic,” Mimeo.

[17] Garratt, R., J. Yu, and H. Zhu (2022) “How Central Bank Digital Currency Design Choices Impact Monetary Policy Pass-Through and Market Composition.”mimeo.

[18] Jiang, J., and Y. Zhu (2021) “Monetary Policy Pass-Through with Central Bank Digital Currency.” Bank of Canada Staff Working Paper.

[19] Keister, T., and D. Sanches (2023) “Should Central Banks Issue Digital Currency?” *Review of Economic Studies*.

[20] Kiyotaki, N., and R. Wright (1993) “A Search-Theoretic Approach to Monetary Economics ” *American Economic Review* 83(1), 63-77.

[21] Lagos, R., and R. Wright (2005) “A Unified Framework of Monetary Theory and Policy Analysis.” *Journal of Political Economy* 113, 463-484.

[22] Li, J. (2023) “Predicting the demand for central bank digital currency: A structural analysis with survey data. ” *Journal of Monetary Economics* 134, 73-85.

[23] Li, J., A. Usher, and Y. Zhu “Central Bank Digital Currency and Banking Choices. ”mimeo.

[24] Ma, Y., Y. Zeng, and A. L. Zhang (2025). Stablecoin runs and the centralization of arbitrage (No. w33882). National Bureau of Economic Research.

[25] Rocheteau, G., and R. Wright (2013). “Liquidity and asset-market dynamics." *Journal of Monetary Economics*, 60(2), 275-294.

[26] Trejos, A., and R. Wright (1995) “Search, Bargaining, Money, and Prices ” *Journal of Political Economy* 103(1), 118-141.

[27] Whited, T., Wu, Y., and Xiao K. (2023). “Will Central Bank Digital Currency Disintermediate Banks?” Working paper, SSRN, 2023

[28] Williamson, S. (2022). “Central bank digital currency: Welfare and policy implications.” *Journal of Political Economy*, 130(11), 2829-2861.

A Omitted Details and Proofs

A.1 Kalai Bargaining

We assume Kalai bargaining for tractability reasons, where the buyer's bargaining power is θ. Then the terms of trade maximizes the buyer's surplus subject to the buyer getting θ fraction of total surplus and buyers cannot pay more than what they have:

$$\begin{aligned}\max_{y_t,\tilde{m}^d_{t-1},\tilde{m}^e_{t-1}} & S^b(y_t,\tilde{m}^d_{t-1},\tilde{m}^e_{t-1})\\ \text{st } & (1-\theta)\,S^b(y_t,\tilde{m}^d_{t-1},\tilde{m}^e_{t-1}) = \theta S^s(y_t,\tilde{m}^d_{t-1},\tilde{m}^e_{t-1})\\ & \tilde{m}^d_{t-1}\le m^d_{t-1},\tilde{m}^e_{t-1}\le m^e_{t-1}\end{aligned}$$

This problem is equivalent to choosing y_t and real balance $\tilde{z}=\frac{R^d_{t-1}\tilde{m}^d_{t-1}+R^e_{t-1}\tilde{m}^e_{t-1}}{P_t}$. Because $\tilde{z}/w_t$ is the continuation value of real balances for both the buyer and the seller, we can rewrite the bargaining problem as

$$\max_{\{y_t,\tilde{z}\}}\left\{u\left(y_t\right)-\frac{\tilde{z}}{w_t}\right\}$$

$$\begin{aligned}\text{st } \theta\left[\frac{\tilde{z}}{w_t}-c(y_t)\right] &= (1-\theta)\left[u\left(y_t\right)-\frac{\tilde{z}}{w_t}\right]\\ \tilde{z} &\le \frac{R^d_{t-1}m^d_{t-1}+R^e_{t-1}m^e_{t-1}}{P_t}\end{aligned}$$

where $c(y_t)$ is a general cost function of producing y_t. In the main text, $c(y_t)=y_t$. The first constraint says that the buyer gets θ fraction while the seller gets $1-\theta$ fraction of the total surplus. The second constraint is the quantity constraints on how much real balance (deposits and coins) one can spend. To solve this problem, we introduce some notations. First, one can rearrange the constraint as $(1-\theta)\,u\left(y_t\right)+\theta c\left(y_t\right)=\tilde{z}/w_t$. Let y^* be the socially efficient DM consumption, which solves $u'(y^*)=c'(y^*)$. Given the constraint of "money" holding, we use the simplifying notations.

Now, let $g\left(y\right)\equiv(1-\theta)\,u\left(y\right)+\theta c\left(y\right)$, then the solution becomes $y=Y(z;w)$ and $\tilde{z}=\min\{z,z^*_t\}$ such that

$$Y\left(z;w_t\right)\equiv\begin{cases}g^{-1}\left(\frac{z}{w_t}\right) & \text{if } z<z^*_t\\ y^* & \text{if } z\ge z^*_t\end{cases}$$

where we define $z^*_t\equiv w_t g\left(y^*\right)$. It means that when liquidity is abundant, consumption will reach the unconstrained level y^*; when liquidity is insufficient, consumption will be constrained by the level of money holding, which is $g^{-1}(z/w_t)$. Using inverse function theorem, we have for $z\le z^*_t$

$$Y'(z;w_t)=\frac{\frac{1}{w_t}}{g'\left(g^{-1}\left(\frac{z}{w_t}\right)\right)}=\frac{1}{w_t g'\left(Y\left(z;w_t\right)\right)}$$

A take-it-or-leave-it offer with $\theta=1$ means that $g(y)=c(y)$. If $c(y)=y$, we therefore have $g(y)=y$ and $g'(.)=1$ and we obtain the results in the main text.

A.2 P2P Lending and New Use Cases of Stablecoins

This section formally develops the extended model considered in Section 4. In each period, three markets open sequentially: a competitive P2P lending market, the DM and the CM. At the beginning of the P2P market, buyers learn whether they have consumption opportunities in the DM. With α probability, a buyer needs to consume in the traditional market where both deposits and stablecoins can be used. With α^e probability, the buyer needs to consume in the digital market, where only the stablecoins can be used. With probability $1-\alpha-\alpha^e$, the buyer does not want to consume. When needing consumption goods in the digital market, the buyer can borrow the stablecoins from those who do not need to consume in the P2P lending market. One interpretation is that if buyers want to engage in transactions on the blockchain, they can utilize financial services such as flash loans to borrow. Let J_t be the value function in the P2P market. Then we can rewrite buyers' CM problem as

$$\begin{aligned} W_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) = & \max_{\{c_t, m_t^e, m_t^d, b_t\}} U\left(c_t\right) - h_t + \beta J_{t+1}\left(m_t^d, m_t^e, b_t\right) \\ & \text{st. } c_t + \frac{m_t^d + m_t^e + q_t^b b_t}{P_t} \\ & = w_t h_t + \frac{R_{t-1}^d m_{t-1}^d + R_{t-1}^e m_{t-1}^e + (1+\rho q_t^b) b_{t-1}}{P_t} + \Delta_t^B + \Delta_t^F + \gamma_t. \end{aligned} \tag{17}$$

The first-order conditions are

$$\begin{aligned} \left[m_t^e\right]: \frac{1}{P_t w_t} &\geq \beta \frac{\partial J_{t+1}\left(m_t^d, m_t^e, b_t\right)}{\partial m_t^d} \\ \left[m_t^d\right]: \frac{1}{P_t w_t} &\geq \beta \frac{\partial J_{t+1}\left(m_t^d, m_t^e, b_t\right)}{\partial m_t^e} \\ \left[b_t\right]: \frac{q_t^b}{P_t w_t} &\geq \beta \frac{\partial J_{t+1}\left(m_t^d, m_t^e, b_t\right)}{\partial b_t} \\ \left[c_t\right]: U'\left(c_t\right) &= \frac{1}{w_t}. \end{aligned}$$

The value function in the P2P market can be written as

$$\begin{aligned} J_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) = & \alpha V_t\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) + \alpha^e J_t^1\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) \\ & + \left(1-\alpha-\alpha^e\right) J_t^0\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right). \end{aligned}$$

where J_t^1 is the value function in the P2P lending market if the buyer wants to consume in the digital market, J_t^0 is the value if the buyer does not want to consume in DM and V_t is DM value function if the buyer wants to consume in the traditional market. It is identical to V_t in the main text.

If buyers want to consume in the digital market, they borrow in a competitive P2P market. Let the gross lending rate be $1+i_t^e$. Then a buyer takes it as given and choose the borrowing quantity

$\hat{m}^e$ to maximize utility. This implies that

$$J_t^1\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) = \max_{\hat{m}^e \geq 0}\left\{V_t^e\left(m_{t-1}^d, m_{t-1}^e + \hat{m}^e, \hat{l}^e, b_{t-1}\right)\right\}$$
$$\text{st } \hat{l}^e = \left(1 + i_t^e\right)\hat{m}^e$$

where $\hat{l}^e = \left(1 + i_t^e\right)\hat{m}^e$ is the amount of stablecoins the the buyer needs to pay back in the next CM and V_t^e is the value function if the buyer wants to consume in the digital market. The FOC in the P2P market is

$$\frac{\partial}{\partial \hat{m}^e} V_t^e\left(m_{t-1}^d, m_{t-1}^e + \hat{m}^e, \hat{l}^e, b_{t-1}\right) + \left(1 + i_t^e\right)\frac{\partial}{\partial \hat{l}^e} V_t^e\left(m_{t-1}^d, m_{t-1}^e + \hat{m}^e, \hat{l}^e, b_{t-1}\right) = 0. \quad (18)$$

One can show that

$$\begin{aligned} V_t^e\left(m_{t-1}^d, m_{t-1}^e, \hat{l}^e, b_{t-1}\right) =& u^e\left(Y\left(\frac{R_{t-1}^e m_{t-1}^e}{P_t}; w_t\right)\right) \\ &- \min\left\{\frac{R_{t-1}^e m_{t-1}^e}{w_t P_t}, \frac{z^*}{w_t}\right\} + W_t\left(m_{t-1}^d, m_{t-1}^e - \hat{l}^e, b_{t-1}\right). \end{aligned}$$

Therefore,

$$\begin{aligned} \frac{\partial}{\partial \hat{m}^e} V_t^1\left(m_{t-1}^d, m_{t-1}^e + \hat{m}^e, \hat{l}^e, b_{t-1}\right) &= \left\{\lambda^e\left(\frac{R_{t-1}^e\left(m_{t-1}^e + \hat{m}^e\right)}{P_t}; w_t\right) + 1\right\}\frac{R_{t-1}^e}{P_t w_t} \\ \frac{\partial}{\partial \hat{l}^e} V_t^1\left(m_{t-1}^d, m_{t-1}^e + \hat{m}^e, \hat{l}^e, b_{t-1}\right) &= -\frac{R_{t-1}^e}{P_t w_t}. \end{aligned}$$

Together with (18), they imply

$$\lambda^e\left(\frac{R_{t-1}^e\left(m_{t-1}^e + \hat{m}^e\right)}{P_t}; w_t\right) = i_t^e.$$

The envelope conditions are

$$\begin{aligned} \frac{\partial}{\partial m_{t-1}^d} J_t^1\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) &= \frac{R_{t-1}^d}{P_t w_t}, \\ \frac{\partial}{\partial m_{t-1}^e} J_t^1\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) &= \frac{R_{t-1}^e}{P_t w_t}\left\{\lambda^e\left(\frac{R_{t-1}^e\left(m_{t-1}^e + \hat{m}^e\right)}{P_t}; w_t\right) + 1\right\} = \frac{R_{t-1}^e\left(1 + i_t^e\right)}{P_t w_t}. \end{aligned}$$

If buyers do not want to consume in the DM, they choose the amount of stablecoins to lend in the P2P market subject to the constraint that they cannot lend more than they have. Then

$$J_t^0\left(m_{t-1}^d, m_{t-1}^e, b_{t-1}\right) = \max_{0 \leq \tilde{m}^e \leq m_{t-1}^e} W_t\left(m_{t-1}^d, m_{t-1}^e - \tilde{m}^e + \hat{l}^e, b_{t-1}\right)$$
$$\text{st } \hat{l}^e = \left(1 + i_t^e\right)\tilde{m}^e$$

If $1+i_t^e>0$, $\hat{m}^e=m_{t-1}^e$ and

$$\frac{\partial}{\partial m_{t-1}^d}J_t^0\left(m_{t-1}^d,m_{t-1}^e,b_{t-1}\right)=\frac{R_{t-1}^d}{P_tw_t}.$$
$$\frac{\partial}{\partial m_{t-1}^e}J_t^0\left(m_{t-1}^d,m_{t-1}^e,b_{t-1}\right)=\frac{\left(1+i_t^e\right)R_{t-1}^e}{P_tw_t}.$$

We can then combine the envelope conditions of J_t^1, J_t^0 and V_t to obtain

$$\frac{\partial J_t\left(m_{t-1}^d,m_{t-1}^e,b_{t-1}\right)}{\partial m_{t-1}^d}=\alpha\frac{R_{t-1}^d}{P_tw_t}\left\{\lambda\left(\frac{R_{t-1}^dm_{t-1}^d+R_{t-1}^em_{t-1}^e}{P_t};w_t\right)+1\right\}+\left(1-\alpha\right)\frac{R_{t-1}^d}{P_tw_t},$$
$$\frac{\partial J_t\left(m_{t-1}^d,m_{t-1}^e,b_{t-1}\right)}{\partial m_{t-1}^e}=\alpha\frac{R_{t-1}^e}{P_tw_t}\left\{\lambda\left(\frac{R_{t-1}^dm_{t-1}^d+R_{t-1}^em_{t-1}^e}{P_t};w_t\right)+1\right\}+\left(1-\alpha\right)\frac{R_{t-1}^e\left(1+i_t^e\right)}{P_tw_t}.$$

Therefore, the Euler equations are

$$[m_t^d]:\frac{1}{P_tw_t}\geq\beta\frac{R_t^d}{P_{t+1}w_{t+1}}\left\{\alpha\lambda\left(\frac{R_{t-1}^dm_{t-1}^d+R_{t-1}^em_{t-1}^e}{P_t};w_t\right)+1\right\}$$
$$[m_t^e]:\frac{1}{P_tw_t}\geq\beta\frac{R_t^e}{P_{t+1}w_{t+1}}\left\{\alpha\lambda\left(\frac{R_{t-1}^dm_{t-1}^d+R_{t-1}^em_{t-1}^e}{P_t};w_t\right)+\left(1-\alpha\right)i_{t+1}^e+1\right\}$$

and the optimal borrowing in the P2P market $\hat{m}_t^e$ solves

$$\lambda^e\left(\frac{R_t^e\left(m_t^e+\hat{m}_t^e\right)}{P_{t+1}};w_{t+1}\right)=i_{t+1}^e,$$

Market clearing in CM implies that $m_t^d=M_t^d$ and $m_t^e=M_t^e$ and the P2P market clearing implies that

$$\alpha^e\left(m_t^e+\hat{m}_t^e\right)=\left(1-\alpha\right)M_t^e.$$

Lastly, recall that $Z_t^d=M_t^d/P_t$, $Z_t^e=M_t^e/P_t$, $\Pi_t=P_t/P_{t-1}$ and $U'\left(c_t\right)=1/w_t$. We can write the equilibrium conditions as

$$U'(c_t)\geq\beta U'(c_{t+1})\left[\alpha\lambda_{t+1}\left(\frac{R_t^dZ_t^d+R_t^eZ_t^e}{\Pi_{t+1}}\right)+(1-\alpha)\lambda_{t+1}^e\left(\frac{R_t^d(1-\alpha)Z^e/\alpha^e}{\Pi_{t+1}}\right)+1\right]\frac{R_t^e}{\Pi_{t+1}},$$

as shown in the main text.

A.3 Proof to Proposition 2

If $R_t^l > R_t^b$, the bank lends until the profit constraint becomes binding.

$$\max_{\{\hat{l},\hat{b},\hat{m}\}} \beta \mathbb{E}_t \left[\frac{R_t^l \hat{l} + R_t^b \hat{b} - \hat{m} \hat{\mathbf{R}}_t \left(\hat{m} + \tilde{M}_t^d + M_t^e \right)}{P_{t+1}} \right]$$
$$\text{st } \hat{l} + \hat{b} = \hat{m} \text{ and } \hat{l} \leq \chi \left[R_t^l \hat{l} + R_t^b \hat{b} - \hat{m} \hat{\mathbf{R}}_t \left(\hat{m} + \tilde{M}_t^d + M_t^e \right) \right],$$

Combine it with $\hat{l} + \hat{b} = \hat{m}$ to obtain

$$\left(1 - \chi R_t^l + \chi R_t^b\right) \hat{l} = \chi \hat{m} \left[R_t^b - \hat{\mathbf{R}}_t \left(\hat{m} + \tilde{M}_t^d + M_t^e \right) \right],$$

which implies

$$\hat{l} = \frac{\chi \hat{m} \left[R_t^b - \hat{\mathbf{R}}_t \left(\hat{m} + \tilde{M}_t^d + M_t^e \right) \right]}{1 - \chi R_t^l + \chi R_t^b}$$

and $\hat{b} = \hat{m} - \hat{l}$. Then, the bank's profit can be rewritten as

$$\beta \mathbb{E}_t \left[\frac{\hat{m} \left[R_t^b - \hat{\mathbf{R}}_t \left(\hat{m} + \tilde{M}_t^d + M_t^e \right) \right]}{\left(1 - \chi R_t^l + \chi R_t^b\right) P_{t+1}} \right]. \tag{19}$$

So the FOC (with respect to $\hat{m}$) implies

$$R_t^b - \hat{\mathbf{R}}_t \left(\hat{m} + \tilde{M}_t^d + M_t^e \right) - \hat{\mathbf{R}}_t' \left(\hat{m} + \tilde{M}_t^d + M_t^e \right) \hat{m} = 0 \tag{20}$$

Applying symmetry condition, we thus obtain the result in the main text. If $R_t^l = R_t^b$, the bank is indifferent between any

$$\hat{l} \in \left[0, \frac{\chi \hat{m} \left[R_t^b - \hat{\mathbf{R}}_t \left(\hat{m} + \tilde{M}_t^d + M_t^e \right) \right]}{1 - \chi R_t^l + \chi R_t^b} \right]$$

and $\hat{b} = \hat{m} - \hat{l}$, with $\hat{m}$ again solving (20). If $R_t^l < R_t^b$, the bank holds only bonds and $\hat{l} = 0$, $\hat{b} = \hat{m}$. Again, $\hat{m}$ solves (20) because the marginal return from deposits is R_t^b.

Now, we show how to obtain the derivative of the demand function. Using the household first-order condition for deposits, we have the total derivatives that satisfy

$$\left\{ \mathbb{E}_t \left[\frac{U_{t+1}'}{\Pi_{t+1}} \left(\alpha \lambda_{t+1} + 1 \right) \right] + \mathbb{E}_t \left[\frac{U_{t+1}' R_t^d}{\Pi_{t+1}} \frac{\alpha \lambda_{t+1}' Z_t^d}{\Pi_{t+1}} \right] \right\} dR_t^d$$
$$+ \mathbb{E}_t \left[\frac{U_{t+1}' R_t^d}{\Pi_{t+1}} \frac{\alpha \lambda_{t+1}' R_t^d}{\Pi_{t+1}} \right] dZ_t^d = 0$$

Then, the derivative

$$\begin{aligned}
&\tilde{\mathbf{R}}_t'\left(Z_t^d+Z_t^e;Z_t^e\right)\\
=&\frac{dR_t^d}{dZ_t^d}\\
=&-\frac{\mathbb{E}_t\left[\frac{U_{t+1}'R_t^d}{\Pi_{t+1}}\frac{\alpha\lambda_{t+1}'R_t^d}{\Pi_{t+1}}\right]}{\mathbb{E}_t\left[\frac{U_{t+1}'R_t^d}{(\Pi_{t+1})^2}\alpha\lambda_{t+1}'Z_t^d\right]+\mathbb{E}_t\left[\frac{U_{t+1}'}{\Pi_{t+1}}\left(\alpha\lambda_{t+1}+1\right)\right]}
\end{aligned}$$

A.4 Equilibrium Conditions

The system of equations is listed below for reference. We solve for 13 variables (C_t, H_t, Z_t^d, Z_t^e, B_t^r, L_t^r, R_t^e, R_t^b, R_t^l, R_t^d, Π_t, T_t, w_t) given (Z_{t-1}^e, Z_{t-1}^d, B_{t-1}, R_{t-1}^e, R_{t-1}^d, R_{t-1}^b, H_{t-1}), by using the following 10 equations and noticing that government policy G_t, B_t^r, T_t, R_t^b, and Z_t^e exogenously set

- Households' Euler equation:

$$\begin{aligned}
U'(C_t/2)&=\beta\mathbb{E}_t\left[U'(C_{t+1}/2)\frac{R_t^d}{\Pi_{t+1}}\left\{\alpha\lambda\left(\frac{R_t^dZ_t^d+R_t^eZ_t^e}{\Pi_{t+1}}\right)+1\right\}\right]\\
U'(C_t/2)&=\beta\mathbb{E}_t\left[U'(C_{t+1}/2)\frac{R_t^e}{\Pi_{t+1}}\left\{\lambda\left(\frac{R_t^dZ_t^d+R_t^eZ_t^e}{\Pi_{t+1}}\right)+1\right\}\right]\\
U'(C_t/2)&=\beta\mathbb{E}_t\left[U'(C_{t+1}/2)\frac{R_t^b}{\Pi_{t+1}}\right]\\
U'\left(C_t/2\right)&=\frac{1}{w_t}
\end{aligned}$$

- Banks' optimal choice (9)

$$R_t^b-R_t^d=-\frac{\frac{Z_t^d}{N}\alpha\left(R_t^d\right)^2\mathbb{E}_t\left[\frac{U_{t+1}'}{(\Pi_{t+1})^2}\lambda'\left(R_t^d\frac{Z_t^d+\xi Z_t^e}{\Pi_{t+1}}\right)\right]}{\alpha R_t^d\mathbb{E}_t\left[\frac{U_{t+1}'}{(\Pi_{t+1})^2}\lambda'\left(R_t^d\frac{Z_t^d+\xi Z_t^e}{\Pi_{t+1}}\right)Z_t^d\right]+\mathbb{E}_t\left[\frac{U_{t+1}'}{\Pi_{t+1}}\left[\alpha\lambda\left(R_t^d\frac{Z_t^d+\xi Z_t^e}{\Pi_{t+1}}\right)+1\right]\right]}$$

- Firms' demand for loan, loan rate, and loan quantity

$$w_tH_t=L_t^r$$

$$\begin{aligned}
Af'\left(H_t\right)&=\mathbb{E}_t\left[\frac{R_t^lw_t}{\Pi_{t+1}}\right],\\
L_t^r&=\frac{\chi Z_t^d\left(R_t^b-R_t^d\right)}{1-\chi R_t^l+\chi R_t^b}.
\end{aligned}$$

- For government policy, B_t^r, T_t, R_t^b, and Z_t^e are exogenously set the, while the tax rate τ_t

satisfy the government budget constraint

$$G_t + \frac{R^e_{t-1} Z^e_{t-1} + R^b_{t-1} B^r_{t-1}}{\Pi_t} + T_t = Z^e_t + B^r_t + \tau_t A f(H_t)$$

- Goods market clearing

$$C_t + G_t = A f\left(H_{t-1}\right)$$

Notice that the real debt held by banks will be backed out from their budget constraint $B^{r,B}_t = Z^d_t - L^r_t$ and the real debt held by households can be solved from the market clearing condition $B^{r,H}_t = B^r_t - B^{r,b}_t$. Finally, we can define money growth as

$$\mu \equiv \frac{M^e_t + M^d_t}{M^e_{t-1} + M^d_{t-1}} = \frac{\left(Z^e_t + Z^d_t\right) P_t}{\left(Z^e_{t-1} + Z^d_{t-1}\right) P_{t-1}} = \frac{Z^e_t + Z^d_t}{Z^e_{t-1} + Z^e_{t-1}} \Pi_t$$

Steady-state equilibrium

We focus on the case $T_t = T$, $G_t = G$, and $\Pi_t = \Pi$. Typically, we set $\Pi = 1$ so that the steady state has zero inflation. In this zero inflation steady-state equilibrium, interest rate and prices are constant over time. From households' FOC for bonds, immediately we have $R^b = \Pi/\beta$. We can solve the steady state equilibrium in the following steps.

First, we treat $\hat{Z}^e = \xi Z^e / w$ as exogenous. Then, as described in the procedure of the main text, we obtain $\tilde{Z}$, $\tilde{Z}^d$, R^d, and R^e. Then, we solve the tax rate τ from the government budget constraint, and thus we are able to calculate the wage rate w accordingly.

Second, we calculate the hours H and consumption C from the goods market clearing condition and the consumption function $C = 2c = 2\left(U'\right)^{-1}(w^{-1})$. The loan level is $L^r = wH$.

Third, the truly exogenous level $Z^e = w\hat{Z}^e/\xi$. Therefore, one can look at the steady state equilibrium for a range of $\hat{Z}^e$ and back out the corresponding Z^e; for any exogenous level Z^e, we find the corresponding steady-state allocation. If the range of Z^e does not cover the exogenous level we are interested in, then we enlarge the range of $\hat{Z}^e$ and repeat the exercise.

A.5 Proof to Lemma 4

From the banking budget

$$(2w + G)\left(\frac{1}{\chi\Pi} + \frac{1}{\beta} - \frac{A(1-\tau)}{w}\right) = AJ(\hat{Z}^e)$$

where we use the feature that given the tax rate τ and the wage rate w, the lending rate is

$$R^l = \frac{A\left(1-\tau\right)}{w}.$$

or a quadratic equation

$$2\Gamma w^2 + \left[\Gamma G - 2A(1-\tau) - AJ(\hat{Z}^e)\right] w - GA(1-\tau) = 0$$

where $\Gamma \equiv \left(\frac{1}{\chi}+\frac{1}{\beta}\right)$. So there is only one positive root because the quadratic function on the left opens upward and is negative when $w=0$. We thus have the unique positive solution w shown in the Lemma.

A.6 Proof to Proposition 5

Combine (14) and (15) to obtain

$$R^d = \frac{1}{1-\alpha}\left(\frac{1}{\beta}-\frac{\alpha}{\tilde{Z}}\right) = \frac{1}{1-\alpha}\left[\frac{1}{\beta}-\frac{2\alpha}{\beta\left(\frac{N-1}{N}\right)+\sqrt{\beta^2\left(\frac{N-1}{N}\right)^2+4\beta\frac{\hat{Z}^e}{N}}}\right].$$

This implies that

$$\begin{aligned}
J\left(\hat{Z}^e\right) =& \tilde{Z}^d\left(\frac{1}{\beta}-R^d\right) = \left[\frac{\beta\left(\frac{N-1}{N}\right)+\sqrt{\beta^2\left(\frac{N-1}{N}\right)^2+4\beta\frac{\hat{Z}^e}{N}}}{2}-\hat{Z}^e\right] \\
&\times\left\{\frac{1}{\beta}-\frac{1}{(1-\alpha)}\left[\frac{1}{\beta}-\frac{2\alpha}{\beta\left(\frac{N-1}{N}\right)+\sqrt{\beta^2\left(\frac{N-1}{N}\right)^2+4\beta\frac{\hat{Z}^e}{N}}}\right]\right\} \\
=& \frac{\alpha}{1-\alpha}\left[\frac{\beta\left(\frac{N-1}{N}\right)+\sqrt{\beta^2\left(\frac{N-1}{N}\right)^2+4\beta\frac{\hat{Z}^e}{N}}}{2}-\hat{Z}^e\right]\left[\frac{2}{\beta\left(\frac{N-1}{N}\right)+\sqrt{\beta^2\left(\frac{N-1}{N}\right)^2+4\beta\frac{\hat{Z}^e}{N}}}-\frac{1}{\beta}\right]
\end{aligned}$$

and

$$S\left(\hat{Z}^e\right) = \hat{Z}^e\left\{\frac{1}{(1-\alpha)}\left[\frac{1}{\beta}-\frac{2\alpha}{\beta\left(\frac{N-1}{N}\right)+\sqrt{\beta^2\left(\frac{N-1}{N}\right)^2+4\beta\frac{\hat{Z}^e}{N}}}\right]-1\right\}.$$

Notice that $J(0)=\alpha/[(1-\alpha)N]$ and $S(0)=0$. If $\hat{Z}^e=0$, then

$$\tau^2-\left(\frac{\alpha}{1-\alpha}\frac{1}{2AN}+1\right)\tau+\frac{(1/\beta-1)B^r\Gamma}{2A}=0. \tag{21}$$

If $(1/\beta-1)B^r\Gamma < A/4$, the equation has two solutions for any given N. In other words, two values of τ can be the equilibrium if $\hat{Z}^e=0$. We focus on the lower solution

$$\tau(0) = \frac{\frac{\alpha}{1-\alpha}\frac{1}{2AN}+1-\sqrt{\left(\frac{\alpha}{1-\alpha}\frac{1}{2AN}+1\right)^2-\frac{2(1/\beta-1)B^r\Gamma}{A}}}{2}.$$

Let $1/\beta=1+r$. If $N<(r+\alpha)/[(1-\alpha)r]$, then $R^d-1<0$. Locally increasing $\hat{Z}^e$ decreases $S\left(\hat{Z}^e\right)$ and $J\left(\hat{Z}^e\right)$. This decreases the coefficient on τ and also the constant in the quadratic equation. Then the lower solution to the quadratic equation must decrease , i.e., $\tau'(0)<0$.

Similarly, as $\hat{Z}^e\to\beta$, $\tilde{Z}^d\to 0$ and $R^d\to 1/\beta$. This implies that $J\left(\hat{Z}^e\right)\to 0$ and $S\left(\hat{Z}^e\right)\to$

$1-\beta$. Then (16) can be rewritten as

$$\tau^2 - \left(\frac{1-\beta}{2}+1\right)\tau + \frac{1-\beta}{2} + \frac{(1/\beta-1)\,B^r\Gamma}{2A} = 0. \tag{22}$$

Therefore,

$$\tau(\beta) = \frac{\frac{1-\beta}{2}+1-\sqrt{\left(\frac{1-\beta}{2}+1\right)^2 - 2(1-\beta) - \frac{2(1/\beta-1)B^r\Gamma}{A}}}{2}.$$

If A is sufficiently large,

$$\frac{1-\beta}{2}+1 > \frac{\alpha}{1-\alpha}\frac{1}{2AN}.$$

This implies that $\tau(\beta) > \tau(0)$. Because $\tau'(0) < 0$, $\tau\left(\hat{Z}^e\right)$ is minimized by some $\hat{Z}^e \in (0,\beta)$, which concludes the proof.