Tokenized Money as Safe Assets

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Abstract

We develop a model in which tokenized money serves both as a medium of exchange and a safe collateral asset. Fiat money is pledged in specialized markets (e.g., cleared derivatives and tri-party repo), but rarely elsewhere. Tokenization lowers venue-specific pledging costs and widens the use of cash as collateral. Pooling tokenized money with risky assets reduces adverse selection, expands pledgeability, raises investment and output, and generates a consumption-securities feedback loop absent under fiat money. Under tokenization, inflation raises haircuts and worsens adverse selection, providing a new monetary transmission channel that breaks the dichotomy between the inflation tax and financial frictions.

Keywords: Tokenized Money, Central Bank Digital Money (CBDC), Tokenized Bank Deposits Digital Payment, Means of Payment, Medium of Exchange, Safe Asset, Collateral Multiplier, Tokenization, Digital Money, Adverse Selection

JEL classification: G10, E42, E44, D82, G12

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Declaration of interests

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1 Introduction

Tokenized money refers to virtual money that is backed, issued, or guaranteed by a central bank. As money and payment systems have become increasingly digital, central banks have recognized the need to provide a public digital alternative, whether in the form of Central Bank Digital Currencies (CBDCs), stablecoins, tokenized money market mutual funds, or tokenized deposits settled on a CBDC ledger.[1]

Despite their growing prominence, the development of tokenized money entails nontrivial challenges, including technological investment, cybersecurity risks, and potential disruptions to the existing financial and monetary architecture.[2] Given the existence of efficient private digital payment options, it is natural to ask whether tokenized money offers economically distinct innovations. We argue that a critical role of tokenized money has been largely overlooked in the academic literature: its role as a safe collateral asset in financial markets. Fiat money is already pledged as collateral, but only in a few specialized markets such as centrally cleared derivatives and tri-party repo, where dedicated institutional arrangements make pledging cheap. Outside these markets, cash is rarely pledged as collateral because of venue-specific pledging costs. Tokenization lowers these costs and broadens the use of safe money as collateral.

The use of money as collateral is not unfamiliar in practice. Cash and cash-equivalent balances are routinely pledged to secure future exchanges in several markets. In foreign exchange transactions, one currency is posted to borrow another. In brokerage and prime-brokerage accounts, cash margin secures positions in securities and derivatives. In employment contracts, a cash component (salary) and an equity or deferred component are bundled to procure long-term labor input. Cash collateral is valuable whenever a transaction involves two-sided commitment: both parties must deliver at a future date, and neither can compel the other ex post. In financial markets, transactions generically involve future obligations on both sides, so collateral is needed. When adverse selection on the underlying asset is severe, safe collateral such as fiat money or government bonds is preferred because its value is insensitive to the private information held by the pledging counterparty.

[1] As of March 2024, 134 countries and currency unions, representing 98% of global GDP, are exploring CBDC initiatives, according to the Atlantic Council CBDC Tracker. Source: https://www.atlanticcouncil.org/cbdctracker/

[2] A key concern is financial disintermediation: the risk that depositors may shift funds from private banks to central bank-issued CBDC accounts, thereby undermining banks' role in credit creation and disrupting monetary transmission mechanisms. In this paper, we abstract from this concern by focusing on a design in which tokenized deposits, backed by deposit insurance, are economically equivalent to CBDC, both being settled on a unified CBDC ledger. This equivalence ensures the "oneness" of tokenized money and removes incentives for deposit migration between forms. The collateral multiplier effect we identify relies on tokenized money being free of default and liquidity risk; tokenized deposits that carry commercial-bank credit or liquidity risk would be less information-insensitive than central-bank money and would deliver a weaker multiplier. The equivalence we assume isolates the polar case in which safety is perfect.

Despite this role, cash is rarely pledged as collateral outside these specialized markets, because of two frictions. First, most money balances are not directly pledgeable. A bank deposit must first be withdrawn, and a money market fund share must first be redeemed and converted to cash, before the balance can travel through traditional payment rails and reach a margin account at a financial intermediary. Each conversion step generates a transfer cost, a custody fee, and a time lag during which the balance cannot simultaneously serve as a means of payment. Second, a bilateral pledge on conventional money requires legal infrastructure to ensure that the pledge is enforceable in default and released on contract performance. Specialized markets, such as centrally cleared derivatives, tri-party repo, and bilateral OTC derivative contracts under the ISDA Credit Support Annex, have paid these fixed costs once and reuse them across many transactions. Outside these markets, every new bilateral pledge pays the costs from scratch, and cash is rarely pledged. Tokenization helps overcome both frictions. Tokenized money is tradable rather than merely redeemable, so a balance can be transferred directly between two accounts on the ledger without the involvement of an intermediary. Tokenized money is also programmable, so collateral conditions and settlement triggers can be embedded in the token itself, replacing bilateral legal negotiation with automated enforcement on the ledger.

The practical use of tokenized cash instruments as collateral is already materializing in both public and private markets. The Swiss National Bank has piloted a wholesale CBDC in Project Helvetia to settle digital securities and repo transactions with CBDC as collateral. Tokenized money market fund shares, such as Franklin Templeton's OnChain U.S. Government Money Fund (FOBXX) and JPMorgan's OnChain Net Yield Fund (MONY), are yield-bearing claims that can be transferred near-instantaneously on public blockchains and pledged as high-quality collateral. BIS and central bank experimentation, including the "Lock" function of Project Rosalind (BIS, 2023) and the atomic settlement of money against securities in Project Pine (BIS, 2025), further illustrates how tokenization supports automated pledge and release of cash collateral.

Given that tokenization starts to widen the use of money as collateral in the broader economy, it is important to understand its implications for financial contracts, consumption, investment, and the transmission of monetary policy. To do so, we build a model in which tokenized money plays dual roles as a payment instrument in the consumption goods market and as a safe collateral asset in the securities market. The model extends the Lagos and Wright (2005) monetary framework by adding an asset-backed securities market a la Ozdenoren, Yuan, and Zhang (2021). Productive agents issue debt backed by portfolios of tokenized money and a risky asset to finance investment. The risky asset is privately held by informed agents, so its quality is known to the issuer but not to the investors in the securities market. The consumption goods market is frictionless. Tokenized money is treated as a safe asset because of its legal tender status and guaranteed convertibility into consumption utility; these attributes generate a safe return for holders, analogous to an interest rate, that makes it pledgeable alongside risky assets.

The main mechanism in the model is that pooling tokenized money with the risky asset in the collateral portfolio lowers the information-sensitivity of the combined collateral. This reduces adverse selection, lowers the haircut, and raises the pledgeability of the risky asset, the borrowing capacity of the entrepreneur, and the level of investment. Moreover, this pooling generates a feedback loop between the consumption goods market and the securities market that is absent under traditional fiat money. An increase in the real value of tokenized money raises the pledgeability of the risky asset and hence its price, which in turn reinforces the demand for tokenized money as a collateral asset. In conventional monetary models, fiat money serves only as a medium of exchange and influences only the consumption side of the economy.

The equilibrium value of tokenized money in our model reflects three related channels. First, tokenized money provides a transaction service by facilitating consumption trades. Second, it offers a direct collateral service, since it can be pledged against debt that finances productive investment. Third, it enhances the pledgeability of the risky asset, which we refer to as the collateral multiplier effect. These three channels jointly link the consumption goods market and the securities market, and produce a tight equilibrium relationship between the price of tokenized money and the price of the risky asset.

Our comparative statics yield a set of empirically testable predictions. An increase in the pledgeable share of tokenized money or in the marginal utility of consumption raises consumption, investment, asset prices, and the face value of debt. Stronger information frictions suppress investment and consumption in both the tokenized and the traditional fiat money regimes, but the effect is mitigated in the tokenized regime, where the added safe collateral offsets adverse selection.

Our main result is about inflation. In the traditional fiat money regime, inflation affects only the real balance of money. Haircuts, the risky asset price, and the level of investment are all independent of the inflation rate because money does not enter the securities market. In the tokenized money regime, however, inflation reduces the real value of tokenized money and hence its contribution to the collateral portfolio. This raises the haircut, worsens adverse selection, and lowers the risky asset price and investment. Tokenization therefore introduces a new transmission channel for monetary policy: inflation tightens collateral constraints in the securities market. In this sense, it breaks the dichotomy between the inflation tax on money balances and the frictions in financial markets. At the same time, in the tokenized regime the risky asset price and investment are quantitatively less sensitive to inflation than consumption is, so that tokenized money also acts as a partial collateral buffer against inflationary disturbances.

Before we move on to the formal model, we pause to discuss the real-world relevance of our mechanism. One might ask whether fiat money already functions as effective collateral, so that tokenization delivers little incremental benefit. Our mechanism is in fact consistent with the observed use of cash as collateral in a few specialized markets. Initial and variation margins on centrally cleared derivatives and prime-brokered positions are posted overwhelmingly in cash or near-cash. Under tri-party repo and securities lending, cash-like eligible collateral reduces haircuts on information-sensitive underlying assets. In stress, agents with access to these markets pledge cash aggressively, as Apple did when it raised \$5.2 billion in repo backed by cash-like collateral during the COVID-19 pandemic (Ozdenoren, Yuan, and Zhang, 2021). Under the ISDA Credit Support Annex, cash is the dominant form of variation margin in bilateral over-the-counter derivative contracts. In each of these settings, the economic role of cash is not to be borrowed against itself, but to reduce information asymmetry and valuation risk in a composite collateral pool. This is exactly the role our model formalizes.

Our point is that this mechanism is at present confined to a few specialized markets. Each of these markets has its own dedicated infrastructure: a centralized party that holds pledged balances and enforces the pledge on default, a standardized framework for valuing and transferring collateral, and membership conditions that restrict direct access to qualified intermediaries. Building and maintaining this infrastructure is a fixed cost, which we call the venue-specific pledging cost of money. Outside the markets where this cost has been paid, cash is rarely pledged as collateral. Small and mid-sized firms, cross-border counterparties, and bilateral arrangements between non-dealer firms hold large cash balances but cannot pledge them at comparable terms. They rely instead on letters of credit, trade-credit insurance, or outright prepayment with its attendant performance risk (Papoutsi et al., 2024; Kotidis, MacDonald, and Malliaropulos, 2023). Papoutsi et al. (2024) document that euro-area corporate loans backed by cash or cash-equivalent collateral carry haircuts of 30 to 40%, an order of magnitude above haircuts on comparable exchange-pledged collateral. During the Greek banking crisis in 2015, foreign counterparties demanded cash collateral, but only agents with pre-existing custodial channels could supply it (Kotidis, MacDonald, and Malliaropulos, 2023). The rest of the economy was rationed out of cash-secured trade. In short, the collateral value of cash depends on the institutional infrastructure that makes pledging enforceable; where that infrastructure is absent or costly, the collateral role of cash largely evaporates.

Tokenization reduces the infrastructure cost of pledging safe money. Because tokenized money is traded on a common ledger rather than redeemed through payment rails, any balance can be transferred directly between two accounts without converting through an intermediary. Because the ledger is programmable, collateral conditions and settlement triggers can be written into the balance itself, replacing bilateral legal negotiation with automated enforcement. In our model, the parameter $\alpha \in [0, 1]$ measures the fraction of tokenized money that can be pledged as collateral. We interpret α as a reduced-form measure of how broadly tokenization extends the pledgeability of safe money beyond the narrow specialized markets where cash is already used as collateral. When $\alpha = 0$, pledging is restricted to the markets where the institutional infrastructure has already been paid for. As α rises, more of the economy gains access to pledging and the effective supply of pledgeable safe collateral rises.

Tokenized money also has properties that distinguish it from other safe assets. Unlike central bank reserves, which are restricted to financial institutions, or sovereign bonds, which face valuation risk and settle in systems segmented from cash payment rails, tokenized money is universally accessible, price-stable, and settlement-final. In extreme stress episodes such as the March 2020 "dash for cash," tokenized money can itself serve as a liquidity backstop, enabling margin payments without forced asset liquidation or costly interbank transfers. By decoupling safe asset provision from sovereign debt issuance, tokenized money can also reduce the financial sector's dependence on sovereign bonds and mitigate the sovereign-financial sector "doom loop" observed during the European sovereign debt crisis.

The remainder of the paper is organized as follows. Section 2 discusses the related literature. Section 3 introduces the model. Section 4 characterizes equilibrium solutions. Section 5 presents comparative statics and numerical results. Section 6 concludes.

2 Related Literature

Our model combines the canonical monetarist model proposed by Lagos and Wright (2005) with a market-based financial intermediation system model in Ozdenoren, Yuan, and Zhang (2021). The lending contract modelled in Ozdenoren, Yuan, and Zhang (2021) is not bank or credit-based, but asset-backed. These asset values are determined in the decentralized capital market rather than trusted third parties such as banks or credit agencies. Therefore, the framework proposed by Ozdenoren, Yuan, and Zhang (2021) lends itself naturally to modeling financial infrastructure in a tokenized economy. Ozdenoren, Yuan, and Zhang (2022) also study payment instruments such as cryptocurrencies that can be used as collaterals for borrowing funds in a Decentralized Finance (DeFi) lending protocol. In their model, cryptocurrencies are risky and exposed to adverse selection. Consequently, DeFi lending is fragile due to self-fulfilling beliefs. Tokenized monies in our paper, on the contrary, are safe assets which help to lower the adverse selection in the lending market.

The economic impact of tokenized money is primarily evaluated through its effects on the banking system and the conduct of monetary policy. A growing body of literature examines how central bank digital currencies (CBDCs) might crowd out traditional bank deposits, potentially leading to financial disintermediation (e.g., Andolfatto 2021, Chiu et al. 2019, Garratt, Yu, and Zhu 2022, Fernandez-Villaverde et al. 2021, Keister and Sanches 2022, Williamson (2022), Niepelt (2023), Whited, Wu, and Xiao (2022), Abad, Nuno, and Thomas (2024), Ahnert et al. (2023), Paul, Ulate, and Wu (2024)). To our knowledge, this paper is the first to analyze the unique role of tokenized money as a safe collateral asset capable of stimulating financial transactions. Within our framework, tokenized central bank money and insured commercial tokenized deposits are economically equivalent; consequently, traditional concerns regarding CBDC-induced bank disintermediation are neutralized. In fact, our model demonstrates that issuing tokenized deposits increases the franchise value of banks' balance sheets due to their utility as safe collateral. By providing this highly demanded service, tokenized deposits actually enhance the banking sector's competitiveness, offering a stark contrast to prevailing narratives that emphasize the disintermediation risks of CBDCs.

By studying tokenized money as collateral, our paper is also related to the broader literature on safe assets. Safe assets are often considered as assets that preserve or appreciate in value during adverse systemic events (Caballero and Farhi (2017), Caballero, Farhi, and Gourinchas (2017), and Brunnermeier and Haddad (In Preparation)). Our paper, like Ozdenoren, Yuan, and Zhang (2023) and Bigio, Weill, and Zuñiga (2024), who study safe asset holding in banks' balance sheet in a static setting, characterizes another feature of safe assets: which is free of information frictions. This is similar to the definition of safe assets as information-insensitive securities in Dang, Gorton, and Holmstrom (2013). The mechanism of creating a pooling portfolio of safe and risky asset for information reasons is also present in Gorton and Ordonez (2013) and Gorton and Ordoñez (2020). The underlying economic rationale is different because the information friction in our model is asymmetric information which leads to adverse selection. They model instead incentives to acquire information in an environment of symmetric ignorance.

3 The Model

The economy is set in discrete time and lasts forever. There are three types of agents. The first type is entrepreneurs who purchase consumption goods with fiat money and raise capital for productive projects in securities markets by issuing asset-backed securities. The second type is producers who provide consumption goods in exchange for fiat money. The third type is investors who provide capital to entrepreneurs in exchange for the asset-backed securities. We assume that entrepreneurs are long lived. Producers and investors live for only one period and make zero profit.

Risky collateral asset A risky asset yields a random payoff in each period t which we denote by $s_t \in [0, \bar{s}]$, where $0 < \bar{s} \leq \infty$. The payoff, s_t, captures both cash payoff that the asset generates, such as dividend or interest rate payment, and other benefits that accrue from the asset such as rental income. We assume that s_t is distributed according to probability distribution F_{Q_t} where $Q_t \in \{L, H\}$ and denotes the quality of the asset. It is independently identically distributed over time with $Q_t = L$ with probability $\lambda \in (0, 1)$. We let $\widetilde{F}_Q(s) = 1 - F_Q(s)$, $Q \in \{L, H\}$ and $\mathbb{E}\tilde{s}_t = \lambda \mathbb{E}_L \tilde{s}_t + (1 - \lambda)\mathbb{E}_H \tilde{s}_t$. We assume F_H dominates F_L in terms of hazard rate:

$$\frac{f_H(s)}{\widetilde{F}_H(s)} < \frac{f_L(s)}{\widetilde{F}_L(s)}$$

for all $s \in [0, \bar{s}]$. There are A units of the risky collateral asset available in the economy. We normalize $A = 1$.

Fiat money There are two types of fiat money: conventional and tokenized money. Entrepreneurs and producers use fiat money to exchange goods in the consumption goods market. In addition, since money is tokenized, it can be used as collateral. Traditional fiat money, on the other hand, cannot be used as collateral. The supply of money in period t is given by M_t taking M_0 as given. We assume that money supply grows at a constant rate and denote the growth rate $\mu = \frac{M_{t+1}}{M_t} > 1$.

We study two cases of collateral usage: when only the risky asset is available as collateral and when the fiat money is tokenized and both the risky asset and the tokenized money are available as collateral. The first case serves as a benchmark to study the impact of introducing tokenized money to this economy.

Time Each time period is divided into four sub-periods. Agents discount future utility with per-period discount factor $0 < \beta < 1$, and there is no discounting between sub-periods. In sub-period 1, entrepreneurs and investors trade securities for capital in a financial market. We refer to the financial market as securities market or Market-S. In subperiod 3, entrepreneurs and producers trade consumption goods for fiat money. We refer to this market as Market-C. In sub-periods 2 and 4, agents settle payments from the previous subperiod and trade fiat money and risky collateral assets in exchange for numeraire goods in competitive asset markets. We refer to these asset markets as AM-1 and AM-2, respectively.

Information environment Entrepreneurs privately observe the quality of the risky asset (L or H) before entering Market-S in subperiod 1. This information is not observed by the investors in Market-S. Hence, there is asymmetric information between the entrepreneurs and investors about the quality of the risky collateral in Market-S. After subperiod 1, this private information becomes common knowledge and information is symmetric across all agents.

Asset markets In both asset markets, agents can produce and consume a numeraire good. The marginal utility of consuming and the marginal cost of producing the numeraire good are both normalized to one. The numeraire good is perishable, and if produced must be consumed within the same subperiod. As will become clear, the numeraire good allows entrepreneurs to balance their budgets in the asset markets. We denote the prices of the fiat money and the risky asset (in terms of the numeraire) in AM-j by ϕ_{jt}^{m} and ϕ_{jt}^{a} where $j \in \{1, 2\}$.

We refer to an entrepreneur's time t continuation value in AM-j by $W_t^j(m, a)$ where m and a are the amounts of money and risky asset that she brings to AM-j.

Securities market In the first subperiod, to benefit from a productive opportunity, an entrepreneur needs to sell a promise/security in exchange for capital in Market-S. We assume that the security is a debt claim with face value D_t. Entrepreneurs face a haircut constraint and they can only borrow a fraction $(1 - h)$ of the expected market value of their collateral where $h \in (0, 1)$. In solving the model, we first take the haircut as a given parameter of the model. We then study the optimal security design where the haircut is chosen to maximize the entrepreneur's expected surplus. To abstract away from signaling concerns, we assume that the security design takes place before the entrepreneur learns her type.

Here we interpret capital broadly as various intermediate goods, labor, foreign currency, or any other productive inputs. Capital can only be created by investors. The marginal cost of creating a unit of capital is constant and equal to 1. The entrepreneur can realize constant marginal benefit $z > 1$ per unit of capital.

We assume that there is two-sided limited commitment problem between the entrepreneurs and the investors. Investors are not able to commit to provide the capital (such as labor), if they are paid upfront by fiat money. At the same time, entrepreneurs are not able to commit to pay back an unbacked loan. As a result, a promised payment must be enforced by collateral assets which can be a pool of the risky collateral asset and, when available, tokenized money. Investors provide capital in exchange for a collateral backed security and the entrepreneur receives the collateral back once the promise is fulfilled.

We refer to an entrepreneur's time t continuation value in Market-S by $V_t^1(m, a)$ where m and a are the amounts of money and risky collateral asset that she brings to Market-S.

Consumption goods market In the third subperiod, in Market-C, entrepreneurs purchase consumption goods from producers who have unit marginal cost. Entrepreneurs must pay for consumption goods with fiat money. In contrast to the securities market, the consumption goods market operates as a spot market where exchange is simultaneous. Producer provides the good and receives the cash from the entrepreneur at the same time.

An entrepreneur's utility from consuming c units of the consumption good is $u(c)$. The utility function u is positive, twice differentiable, increasing and concave, i.e. $u(c) > 0$ for $c > 0$, $-\infty < u''(c) < 0 < u'(c)$ for $c > 0$. To guarantee there is positive consumption in equilibrium, we further assume that utility is increasing sufficiently rapidly near zero consumption so that $u'(0^+) > 1 + \frac{1-\beta}{\beta\gamma}$, $u'(c) + cu''(c) \in (0, 1)$, $\lim_{c\to\infty}[u'(c) + cu''(c)] = 0$ and $-\frac{u'(c)}{cu''(c)} \in \left(1, \frac{z}{z-1}\right)$.

We refer to an entrepreneur's time t continuation value in Market-C by $V_t^2(m, a)$ where m and a are the amounts of money and risky collateral asset that she brings to Market-C.

Timeline Figure 1 summarizes the event timeline of this economy within each time period.

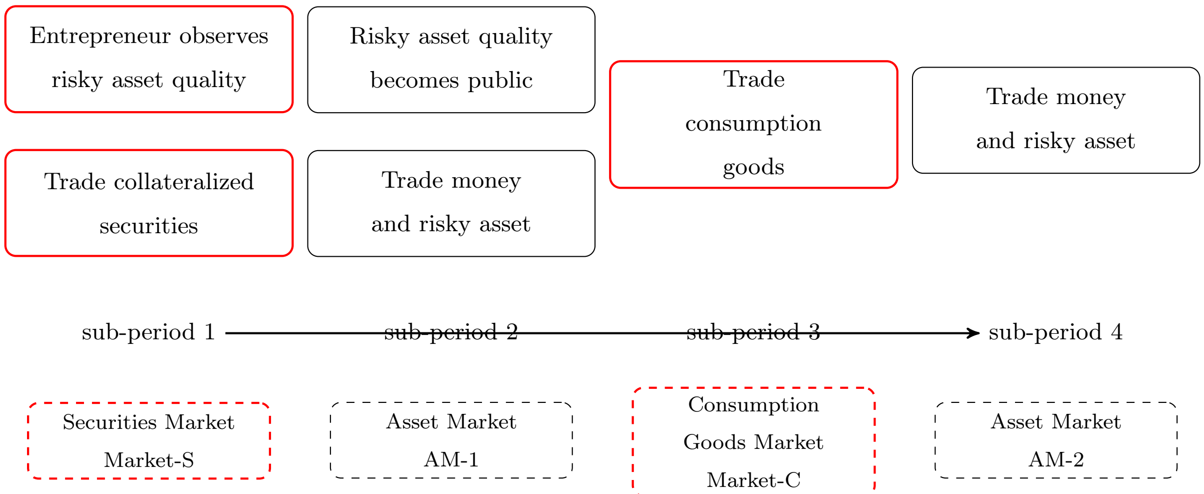
3.1 Equilibrium Definition

Definition 1. Suppose initial money supply M_0 and the growth rate of money supply μ. A stationary monetary equilibrium is asset prices ϕ_1^a, ϕ_2^a, real money balances $Z_1 = \phi_{1t}^m M_t$, $Z_2 = \phi_{2t}^m M_t$ such that, given the asset prices and real money balances:

1) in asset markets AM-1 and AM-2, the entrepreneur chooses the optimal amounts of money and risky asset to take to the next sub-period;

2) in Market-C the entrepreneur chooses optimally how much to consume and how much money and asset to retain;

Figure 1: Timeline



3) the haircut h is such that both types of entrepreneurs participate in the security market, the entrepreneur's expected surplus generated in Market-S is maximized and investors break even;

4) the asset markets clear, i.e. the entrepreneur's demand for the risky asset and money in AM-j where $j \in \{1, 2\}$ equals the risky asset and money supply, respectively.

We also study the partial equilibrium case where the haircut h is a fixed parameter. In that case we modify part 3 of the equilibrium definition so that given the haircut both types of entrepreneurs participate in the security market and the investors break even.

4 Consumption and Investment Problems

We first solve for the entrepreneur's optimization problem in each market taking the asset prices and debt contract terms as given.

4.1 The Entrepreneur's Problem in AM-2

In AM-2, the entrepreneur decides how much money and risky asset to bring to the securities market (which takes place in the first sub-period of the next period) given her endowment of money, $\hat{m}$, and risky asset, $\hat{a}$. The entrepreneur can produce/consume the numeraire good, denoted by n, to balance her budget. Her optimization problem in AM-j can be expressed as:

$$W_t^2(\hat{m},\hat{a}) = \max_{n,\tilde{m},\tilde{a}} -n + \beta V_{t+1}^1(\tilde{m},\tilde{a})$$

subject to

$$\phi_{2t}^m \tilde{m} + \phi_{2t}^a \tilde{a} \leq \phi_{2t}^m \hat{m} + \phi_{2t}^a \hat{a} + n.$$

Substituting for n, we obtain

$$\begin{aligned} W_t^2(\hat{m},\hat{a}) &= \phi_{2t}^m \hat{m} + \phi_{2t}^a \hat{a} + \left[\max_{\tilde{m},\tilde{a}} -\phi_{2t}^m \tilde{m} - \phi_{2t}^a \tilde{a} + \beta V_{t+1}^1(\tilde{m},\tilde{a})\right] \\ &= \phi_{2t}^m \hat{m} + \phi_{2t}^a \hat{a} + W_t^2(0,0). \end{aligned}$$

The first order conditions for the entrepreneur's optimization problem in AM-2 are:

$$\phi_{2t}^m = \beta \frac{\partial}{\partial m} V_{t+1}^1 \left(\tilde{m},\tilde{a}\right), \tag{1}$$

and

$$\phi_{2t}^a = \beta \frac{\partial}{\partial a} V_{t+1}^1 \left(\tilde{m},\tilde{a}\right). \tag{2}$$

4.2 The Entrepreneur's Problem in Market-C

Suppose the entrepreneur enters Market-C with $\hat{m}$ units of fiat money and $\hat{a}$ units of the risky asset. We assume that the entrepreneur makes the producer a take-it-or-leave-it offer of $\hat{m} - \tilde{m} \geq 0$ units of the fiat money in exchange for c units of the consumption good. Hence, if the producer accepts the offer, the entrepreneur retains $\tilde{m} \geq 0$ units of money with which she enters AM-2, and the producer enters AM-2 with $\hat{m} - \tilde{m}$ units of money, which he sells at price ϕ_{2t}^m and obtains $\phi_{2t}^m \left(\hat{m} - \tilde{m}\right)$ units of the numeraire good. If the producer refuses the offer, he obtains reservation value of zero. Hence, we can write the entrepreneur's value function as:

$$V_t^2(\hat{m},\hat{a}) = \max_{c,\tilde{m}\geq 0} u(c) + W_t^2(\tilde{m},\hat{a})$$

subject to

$$c \leq \phi_{2t}^m \left(\hat{m} - \tilde{m}\right).$$

The above constraint can be viewed as either the budget constraint for the entrepreneur or the participation constraint of the producer. Since the constraint must be satisfied with equality, we can substitute for c and write the entrepreneur's value function as:

$$V(\hat{m},\hat{a}) = \max_{\tilde{m}\geq 0} u\left[\phi_{2t}^m \left(\hat{m} - \tilde{m}\right)\right] + \phi_{2t}^m \tilde{m} + \phi_{2t}^a \hat{a} + W_t^2(0,0). \tag{3}$$

The first order condition for the the entrepreneur's optimization problem is:

$$-\phi_{2t}^{m} u' \left[\phi_{2t}^{m}(\hat{m} - \tilde{m})\right] + \phi_{2t}^{m} \leq 0$$

or

$$u' \left[\phi_{2t}^{m}(\hat{m} - \tilde{m})\right] \geq 1 \tag{4}$$

with equality if $\tilde{m} > 0$.

4.3 The Entrepreneur's Problem in AM-1

The entrepreneur's optimization problem in AM-1 is similar to her problem in AM-2 except that AM-1 is followed by the consumption goods market that takes place in the same period. So the entrepreneur's optimization problem is:

$$W_t^1(\hat{m}, \hat{a}) = \max_{n, \tilde{m}, \tilde{a}} -n + V_t^2(\tilde{m}, \tilde{a})$$

subject to

$$\phi_{1t}^{m}\tilde{m} + \phi_{1t}^{a}\tilde{a} \leq \phi_{1t}^{m}\hat{m} + \phi_{1t}^{a}\hat{a} + n$$

Substituting for n,

$$\begin{aligned} W_t^1(\hat{m}, \hat{a}) &= \phi_{1t}^{m}\hat{m} + \phi_{1t}^{a}\hat{a} + \left[\max_{\tilde{m}, \tilde{a}} -\phi_{1t}^{m}\tilde{m} - \phi_{1t}^{a}\tilde{a} + V_t^2(\tilde{m}, \tilde{a})\right] \\ &= \phi_{1t}^{m}\hat{m} + \phi_{1t}^{a}\hat{a} + W_t^1(0, 0) \end{aligned}$$

The first order conditions for the entrepreneur's optimization problem in AM-1 are:

$$\phi_{1t}^{m} = \frac{\partial}{\partial m} V_t^2(\tilde{m}, \tilde{a}) \tag{5}$$

$$\phi_{1t}^{a} = \frac{\partial}{\partial a} V_t^2(\tilde{m}, \tilde{a}) \tag{6}$$

4.4 Market-S with Traditional Fiat Money

Suppose the entrepreneur enters Market-S with $\hat{a}$ units of the collateral asset and issues a debt claim with face value D_t, backed by the collateral asset price and its dividend. The debt security promises to pay:

$$y_t = \min(\tilde{s}_t + \phi_{1t}^{a}, D_t). \tag{7}$$

Let p_t denote the price of the security y_t. We assume the following haircut constraint.

$$p_t \leq \{\mathbb{E}\tilde{s}_t + \phi_{1t}^a\}(1-h) \tag{8}$$

which means that maximum amount of the borrowed fund (that is, the price of the loan) cannot exceed the expected payoff of the risky asset subject to a haircut h.

Since the security is backed by the collateral the entrepreneur can sell at most $\hat{a}$ units of the security and conditions her decision about how many units of the security to sell on her private information about the collateral quality. Let a_L and a_H denote the quantity of debt security sold by types L and H, respectively. The price of the security is determined by the breakeven condition for the sellers:

$$p_t = \frac{1}{a_L\lambda + a_H(1-\lambda)}\left[a_L\lambda\mathbb{E}_L\min\left(\tilde{s}_t+\phi_{1t}^a, D_t\right) + a_H(1-\lambda)\mathbb{E}_H\min\left(\tilde{s}_t+\phi_{1t}^a, D_t\right)\right]. \tag{9}$$

In a separating equilibrium $a_L > 0$ and $a_H = 0$. In a pooling equilibrium $a_L = a_H > 0$. In this paper, we focus on the pooling equilibrium and omit the word 'pooling' for brevity, unless otherwise noted.[3] Instead of the face value of the security D_t, it is more convenient to work with the threshold over the asset dividend given by $\delta_t = D_t - \phi_{1t}^a$, which we term as the debt threshold to distinguish from the debt face value D_t. In a pooling equilibrium, the break even condition (9) becomes:

$$p_t = \phi_{1t}^a + \lambda\mathbb{E}_L\min\left(\tilde{s}_t, \delta_t\right) + (1-\lambda)\mathbb{E}_H\min\left(\tilde{s}_t, \delta_t\right). \tag{10}$$

Combining with the haircut constraint (8) we obtain:

$$\phi_{1t}^a + \lambda\mathbb{E}_L\min\left(\tilde{s}_t, \delta_t\right) + (1-\lambda)\mathbb{E}_H\min\left(\tilde{s}_t, \delta_t\right) \leq (1-h)\left(\mathbb{E}\tilde{s}_t + \phi_{1t}^a\right). \tag{11}$$

The left side of (11) is increasing in δ_t. The face value implied by the haircut is given by:

$$\delta^c = \arg\max_{0\leq\delta\leq\overline{s}}\left\{\delta \text{ s.t. } h\phi_{1t}^a + \lambda\mathbb{E}_L\min\left(\tilde{s}_t, \delta\right) + (1-\lambda)\mathbb{E}_H\min\left(\tilde{s}_t, \delta\right) \leq (1-h)\mathbb{E}\tilde{s}_t\right\}. \tag{12}$$

Note that either (11) is binding and $0 \leq \delta^c \leq \overline{s}$ or (11) is not binding and $\delta^c = \overline{s}$. The debt is traded in the pooling equilibrium if and only if the high type borrower prefers to sell the debt security at the pooling price:

$$zp_t = z\left\{\phi_{1t}^a + \lambda E_L\left[\min(\tilde{s}_t, \delta^c)\right] + (1-\lambda)E_H\left[\min(\tilde{s}_t, \delta^c)\right]\right\} \geq \phi_{1t}^a + E_H\left[\min(\tilde{s}_t, \delta^c)\right]$$

[3]In our previous work, we investigated the possibility of multiple equilibria in environments that are related to the one we present here. For example, we can show that with a fixed haircut there is possibility of multiple equilibria when the haircut is small. We can also show that there is a unique equilibrium when the haircut is large enough. With optimal security design, haircut would be chosen flexibly so that the high type's incentive constraint is exactly binding.

which can be written as

$$\phi_{1t}^{a} \geq \frac{1-z(1-\lambda)}{z-1} E_H \left[\min(\tilde{s}_t, \delta^c)\right] - \frac{z\lambda}{z-1} E_L \left[\min(\tilde{s}_t, \delta^c)\right]. \tag{13}$$

For a different perspective, we write the above pooling condition as:

$$\frac{\phi_{1t}^{a} + E_L \left[\min(\tilde{s}_t, \delta^c)\right]}{\phi_{1t}^{a} + E_H \left[\min(\tilde{s}_t, \delta^c)\right]} \geq 1 - \frac{z-1}{\lambda z} \equiv \zeta. \tag{14}$$

The left hand side of (14) captures the degree of adverse selection. As this ratio increases, the expected payment of the debt security when the collateral is low quality gets closer to its expected payment when the collateral is high quality. This ratio can be interpreted as the information insensitivity ratio of a debt with a debt threshold of δ^c. In the edge case where δ^c is close to 0, this ratio is close to one and there is almost no adverse selection. In this case, degree of adverse selection exceeds the pooling threshold $\zeta < 1$ and the pooling condition is satisfied. As δ^c increases, degree of adverse selection increases (i.e. the ratio decreases). The threshold ζ depends on the probability of the low type, λ, and the productivity of the investment, z.

In a pooling equilibrium the entrepreneur's value function in Market-S is given by:

$$\begin{aligned} V_t^1(\hat{m}, \hat{a}) = (z-1)\hat{a}\left[\phi_{1t}^{a} + \lambda E_L\left[\min(s_t, \delta^c)\right] + (1-\lambda)E_H\left[\min(s_t, \delta^c)\right]\right] \\ + \phi_{1t}^{m}\hat{m} + \mathbb{E}\tilde{s}_t\hat{a} + \phi_{1t}^{a}\hat{a} + W_t^1(0,0). \end{aligned}$$

4.5 Equilibrium with Traditional Fiat Money

4.5.1 Exogenous Haircut

The entrepreneur will not bring too much money to Market-C so we must have $u'(\phi_{2t}^{m}\hat{m}) \geq 1$. From (3) we obtain

$$\frac{\partial}{\partial \hat{m}} V_t^2(\hat{m}, \hat{a}) = \phi_{2t}^{m} u'(\phi_{2t}^{m}\hat{m}), \; \frac{\partial}{\partial \hat{a}} V_t^2(\hat{m}, \hat{a}) = \phi_{2t}^{a}.$$

Using market clearing for money ($\hat{m} = M_t$), (5) and (6) we get:

$$\phi_{1t}^{m} = \phi_{2t}^{m} u'\left(\phi_{2t}^{m} M_t\right), \; \phi_{1t}^{a} = \phi_{2t}^{a}.$$

From (1) and (5) we get

$$Z_1 = Z_2 u'\left(Z_2\right) \text{ and } Z_2 = \frac{\beta}{\mu} Z_1. \tag{15}$$

We next turn to solve for the collateral asset price. We first plug (12) into the expression for $V_t^1(\hat{m}, \hat{a})$ to obtain:

$$V_t^1(\hat{m}, \hat{a}) = \left(z\left(1-h\right) + h\right)\hat{a}\left[\phi_1^a + \mathbb{E}\tilde{s}_t\right] + \phi_{1t}^{m}\hat{m} + W_t^1(0,0).$$

From (2) we obtain the stationary collateral asset price as:

$$\phi_1^a = \phi_2^a = \frac{\beta\left(z\left(1-h\right)+h\right)}{1-\beta\left(z\left(1-h\right)+h\right)}\mathbb{E}\tilde{s}_t \tag{16}$$

The following proposition shows that a stationary (pooling) equilibrium exists for a large enough haircut.

Proposition 1. *In an economy that does not use tokenized money and where the haircut is fixed, there exists at least one stationary pooling equilibrium for* $h \in \left[\overline{h}-\epsilon, \overline{h}\right]$ *where* $\overline{h} = \frac{1-\beta z}{1-\beta(z-1)}$ *and* $\epsilon > 0$ *and small enough. In a stationary equilibrium real money balances satisfy (15). Asset prices* ϕ_1^a *and* ϕ_2^a *satisfy (16) and face value* δ^c *satisfies (11) and (13).*

At the maximal haircut level (i.e., $h = \overline{h}$), the debt threshold (δ^c) is zero by the investors' break-even condition and a stationary pooling equilibrium exists. The proposition establishes that such an equilibrium exists whenever the haircut is sufficiently close to $h = \overline{h}$.

4.5.2 Optimal security design

With optimal security design, haircut is set as low as possible while satisfying the pooling constraint. Denote the optimal haircut by h^*. If $h^* > 0$ then (13) must be binding. If $h^* = 0$ then the pooling constraint is either not binding or holds with equality at $h^* = 0$. The next proposition shows that a stationary equilibrium exists with the optimal choice of haircut.

Proposition 2. *In the economy that does not use tokenized money and where the haircut is optimally chosen, there exists at least one stationary equilibrium. In any such equilibrium, the optimal haircut* h^* *is in* $\left[0, \overline{h}\right]$*; real money balances satisfy (15); asset prices* ϕ_1^a *and* ϕ_2^a *satisfy (16). Moreover, if* $h^* > 0$ *then* h^* *and the corresponding face value* δ^* *satisfy both (11) and (13) with equality. If* $h^* = 0$ *then (11) holds with equality and (13) holds.*

As the haircut increases, the debt threshold decreases due to the investors' break-even condition. Consequently, the collateralized debt becomes less information-sensitive and is more likely to satisfy the pooling condition. Given that $z > 1$, gains from trade are maximized when the loan amount is the highest (i.e., when the haircut is the smallest). Therefore, the optimal haircut is the smallest value that equates the information insensitivity ratio with the pooling threshold ζ in (14). This proposition characterizes the values of the optimal haircut h^* and δ^* in such a stationary pooling equilibrium.

In a setting where fiat money functions exclusively as a medium of exchange in the consumption-goods market, its value is determined by the marginal utility it provides in facilitating consumption trades. The risky asset's price, by contrast, equals the discounted present value of its future dividend stream plus the collateral service it supplies when pledged against debt used to finance the productive z-technology. Because the securities market that prices the asset and the consumption-goods market that values money operate independently, no equilibrium linkage arises between the price of money and the price of the risky asset.

4.6 Market-S with Tokenized Money

In sub-periods 2 to 4 the entrepreneur's problem is the same with tokenized and traditional fiat money. However, the existence of tokenized money affects the analysis of the securities market in sub-period 1 since the entrepreneur can pledge a portfolio consisting of safe tokenized money and the risky asset to back her debt claim. Suppose a fraction α of the tokenized money can be pledged as collateral. When $\alpha = 0$ the model reduces to the benchmark with fiat money where money cannot be collateralized. When $\alpha = 1$ the agent can use all of her tokenized money holdings as collateral. We interpret α as a reduced-form measure of how broadly tokenization extends the pledgeability of safe money beyond the narrow set of specialized markets (such as margin, tri-party repo, and bilateral derivative contracts) where cash is already used as collateral. At $\alpha = 0$, pledging is restricted to those markets. As α rises, more of the economy gains access to pledging. The debt security promises to pay

$$y = \min(\tilde{s} + \phi_1^a + \frac{\alpha \hat{m}}{\hat{a}} \phi_1^m, D). \tag{17}$$

The haircut constraint with tokenized money is given by

$$p_t \leq \left\{ \mathbb{E}\tilde{s}_t + \phi_{1t}^a + \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m \right\} (1-h) \tag{18}$$

Letting $\delta_t = D - \phi_{1t}^a - \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m$, the pooling security price is

$$p_t = \phi_{1t}^a + \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m + \lambda \mathbb{E}_L \min\left(\tilde{s}_t, \delta_t\right) + (1-\lambda)\, \mathbb{E}_H \min\left(\tilde{s}_t, \delta_t\right). \tag{19}$$

Combining with the haircut constraint we obtain:

$$\phi_{1t}^a + \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m + \lambda \mathbb{E}_L \min\left(\tilde{s}_t, \delta_t\right) + (1-\lambda)\, \mathbb{E}_H \min\left(\tilde{s}_t, \delta_t\right) \leq \left\{ \mathbb{E}\tilde{s}_t + \phi_{1t}^a + \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m \right\} (1-h). \tag{20}$$

The left side of (20) is increasing in δ_t. The face value implied by the haircut is given by:

$$\delta^c = \arg\max_{0 \leq \delta \leq \bar{s}} \left\{ \delta \text{ s.t. } h\left(\phi_{1t}^a + \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m\right) + \lambda \mathbb{E}_L \min\left(\tilde{s}_t, \delta\right) + (1-\lambda)\, \mathbb{E}_H \min\left(\tilde{s}_t, \delta\right) \leq (1-h)\mathbb{E}\tilde{s}_t \right\}. \tag{21}$$

Note that either (20) is binding and $0 \leq \delta^c \leq \overline{s}$ or (20) is not binding and $\delta^c = \overline{s}$. The debt is traded in the pooling equilibrium if and only if :

$$\phi_{1t}^a + \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m \geq \frac{1 - z(1-\lambda)}{z-1} E_H \left[\min(\tilde{s}_t, \delta^c) \right] - \frac{z\lambda}{z-1} E_L \left[\min(\tilde{s}_t, \delta^c) \right]. \tag{22}$$

Similar to the fiat money case, we can write the pooling condition in terms of the following ratio:

$$\frac{\phi_{1t}^a + E_L \left[\min(\tilde{s}_t, \delta^c) \right] + \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m}{\phi_{1t}^a + E_H \left[\min(\tilde{s}_t, \delta^c) \right] + \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m} \geq \zeta. \tag{23}$$

Observe that the information insensitivity ratio in (23) increases in the pledgeability of tokenized money, α. Hence, combining tokenized money with the risky asset mitigates the severity of the adverse selection problem. The pooling condition is easier to satisfy when money is used as collateral than the fiat money case when it is not (i.e., condition stated in (14)).

Finally, in a pooling equilibrium the entrepreneur's value function in Market-S is given by:

$$V_t^1(\hat{m}, \hat{a}) = (z-1)\hat{a} \left[\phi_{1t}^a + \frac{\alpha \hat{m}}{\hat{a}} \phi_{1t}^m + \lambda E_L \left[\min(s_t, \delta_t) \right] + (1-\lambda) E_H \left[\min(s_t, \delta_t) \right] \right]$$
$$+ \phi_{1t}^m \hat{m} + \mathbb{E}\tilde{s}_t \hat{a} + \phi_{1t}^a \hat{a} + W_t^1(0,0).$$

4.7 Equilibrium with Tokenized Money

4.7.1 Exogenous haircut

Following the steps in Section 4.5.1, we obtain:

$$\phi_{1t}^m = \phi_{2t}^m u' \left(\phi_{2t}^m M_t \right), \ \phi_{1t}^a = \phi_{2t}^a.$$

Plugging (21) into the expression for $V_t^1(\hat{m}, \hat{a})$ we obtain:

$$V_t^1(\hat{m}, \hat{a}) = \left[1 + \alpha(z-1)(1-h) \right] \hat{m} \phi_{1t}^m + \left(1 + (z-1)(1-h) \right) \hat{a} \left[\phi_{1t}^a + \mathbb{E}\tilde{s}_t \right] + W_t^1(0,0).$$

From (1) and (5) we get

$$Z_2 = \frac{\beta}{\mu} Z_1 \left(1 + \alpha(z-1)(1-h) \right), \ Z_1 = Z_2 u' \left(Z_2 \right). \tag{24}$$

We next turn to solve for the collateral asset price. From (2) we see that the expression for the stationary collateral asset price is

$$\phi_1^a = \phi_2^a = \frac{\beta \left(z(1-h) + h \right)}{1 - \beta \left(z(1-h) + h \right)} \mathbb{E}\tilde{s}_t \tag{25}$$

We next prove that a stationary equilibrium exists. As a preliminary step, we prove a lemma.

Lemma 1. *Denote by $Z_1(h)$ and $Z_2(h)$ solutions to (24) as functions of h. Then, $\frac{\partial Z_2(h)}{\partial h} < 0$, $\frac{\partial Z_1(h)}{\partial h} < 0$ and $\frac{\partial (h Z_1(h))}{\partial h} > 0$.*

This lemma gives the first glimpse of the linkage between security markets and value of money by showing that when the haircut is larger, real money balances are lower. The lemma also establishes that the drop in real money balance Z_1 is not too large.[4]

Next, we define a threshold haircut $\hat{h}$ is such that

$$\left(1 - \frac{\hat{h}}{1 - \beta\left(z\left(1 - \hat{h}\right) + \hat{h}\right)}\right) \mathbb{E}\tilde{s} - \hat{h}\alpha Z_1\left(\hat{h}\right) = 0. \tag{26}$$

By Lemma 1 there is a unique $\hat{h}$ satisfying equation (26).

Proposition 3. *In the economy with tokenized money and where the haircut is fixed, there exists at least one stationary equilibrium for $h \in \left[\hat{h} - \epsilon, \hat{h}\right]$ and $\epsilon > 0$ and small enough. In a stationary equilibrium real money balances satisfy (24). Asset prices ϕ_1^a and ϕ_2^a satisfy (25) and face value δ^c satisfies (20) and (22).*

Proposition 3 is similar to the corresponding result in Proposition 1 for the traditional fiat money case except that the maximal haircut level here is $\hat{h}$ instead of $\overline{h}$. This proposition establishes that a stationary equilibrium under tokenized money regime exists whenever the haircut is sufficiently close to $h = \hat{h}$.

4.7.2 Optimal security design

The next proposition shows that a stationary equilibrium exists with optimal choice of haircut.

Proposition 4. *In the economy with tokenized money and where the haircut is optimally chosen, there exists at least one stationary equilibrium. In any such equilibrium, optimal haircut h^* is in $\left[0, \hat{h}\right]$; real money balances satisfy (24); asset prices ϕ_1^a and ϕ_2^a satisfy (25). Moreover, if $h^* > 0$ then h^* and the corresponding face value δ^* satisfy both (20) and (22) with equality. If $h^* = 0$ then (20) holds with equality and (22) holds.*

Similar to Proposition 2, this proposition characterizes the values of the optimal haircut h^* and δ^* in a stationary pooling equilibrium when the haircut is set optimally. Given the equilibrium solutions under both tokenized and no-tokenized money regimes, we are now ready to study their equilibrium properties.

[4]Specifically, the percentage decrease in real money balance Z_1 is less than the percentage increase in the haircut.

5 Equilibrium Properties of Tokenized Money

Tokenized money serves simultaneously as a medium of exchange in the consumption-goods market and as a safe collateral asset in the securities market, so its equilibrium value rests on three intertwined channels. First, it carries the conventional transaction motive: agents derive marginal utility from holding it to facilitate consumption trades. Second, it delivers a direct collateral service, since it can be pledged against debt that finances investment in the productive z-technology. Third, tokenized money enhances the pledgeability of the risky asset itself, a collateral-multiplier effect that reinforces both borrowing capacity and asset demand. Because these channels link the consumption and securities markets, the price of tokenized money and the price of the risky asset become tightly connected in equilibrium.

To demonstrate these linkages, we examine how the digitalization of tokenized money, monetary policy, and the enhanced convenience yield of money affect the pledgeability of the risky asset, and consequently, the levels of borrowing capacity and investment, money prices, and asset prices in the economy. We do so by deriving comparative statics with respect to the fraction of collateralizable tokenized money, inflation level, and marginal utilities of consumption.

When the pooling constraint is not binding, the haircut is zero and a small change in any of the exogenous parameters does not affect the haircut. Hence, in our comparative statics results we assume that the pooling constraint is violated at $h = 0$ and the optimal haircut is strictly positive.

5.1 Comparative Statics: Fraction of Collateralizable Tokenized Money

Now, we study the impact of the collateralizable fraction of tokenized money on the money prices, the risky asset price, the haircut and hence the pledgeability of the risky asset in the economy.

The following lemma shows that real money balances in the two asset markets (AM-1 and AM-2) increase when the collateralizable fraction of tokenized money increases.

Lemma 2. *For a fixed haircut h, as α increases, real balances of money Z_1 and Z_2 both increase.*

That is, as the pledgeability of the risky asset goes up, its value increases. This result is obtained by taking the derivatives from (24):

$$\frac{\partial Z_2}{\partial \alpha} = -\frac{u'(Z_2)(z-1)(1-h)}{u''(Z_2)(1+\alpha(z-1)(1-h))} > 0,$$

and

$$\frac{\partial Z_1}{\partial \alpha} = \left(u'\left(Z_2\right) + Z_2 u''\left(Z_2\right)\right) \frac{\partial Z_2}{\partial \alpha} > 0.$$

The next proposition states that when more of tokenized money is pledgeable, the haircut on the collateralized loan decreases.

Proposition 5. *The optimal haircut is strictly decreasing and the asset price is increasing in* α*.*

An increase in the pledgeability parameter α for tokenized money eases the adverse-selection friction through two mutually reinforcing channels. First, equation (23) shows that a higher α loosens the pooling constraint, directly mitigating adverse selection. Second, Lemma 2 demonstrates that the same rise in α raises the real value of money; this appreciation shifts a larger share of the collateral portfolio toward the safe asset and thus further reduces informational asymmetries.

With the adverse-selection problem less severe, investors accept smaller haircuts and allow entrepreneurs to pledge a greater fraction of the risky asset's stochastic dividend stream as collateral for productive lending. When haircut falls, asset price increases which generates a link between money and the risky asset price in the economy. This proposition therefore underscores a distinctive and economically significant function of tokenized money: it acts as a collateral multiplier, expanding the economy's effective stock of pledgeable assets.

5.2 Comparative Statics: Inflation

Here, we study the feedback between consumption and financial markets by characterizing the impact of inflation on the value of money and asset prices. We begin with a preliminary lemma.

Lemma 3. *For a fixed haircut* h*, as inflation* μ *increases, real balances of money* Z_1 *and* Z_2 *both decrease.*

Next, we show that as inflation goes up, the optimal haircut goes up. This result is also interesting in its own right since it links optimal security design and the value of money.

Proposition 6. *In the tokenized-money regime (*$\alpha > 0$*), the optimal haircut is strictly increasing and the asset price is decreasing in* μ*. (In the no-tokenized regime, both are independent of* μ*.)*

This finding illuminates the collateral-multiplier function of tokenized money from an inflationary perspective, complementing Proposition 5, which examined the same mechanism by varying pledgeability directly. When inflation rises, the real value of tokenized money depreciates, shrinking its weight in the collateral portfolio. With a smaller safe-asset share, informational asymmetries intensify, and the effective pledgeability of the remaining risky collateral declines, resulting in a large haircut. When haircut increases, asset price decreases further highlighting the linkage between the value of money and the risky asset price.

5.3 Comparative Statics: Marginal Utility of Consumption

Here, we study the impact of marginal utility on money prices, haircut and assets. Suppose we parametrize the utility function so that $u(x;\gamma) = \gamma u(x)$. We derive comparative statics results with respect to γ. We start with the following Lemma.

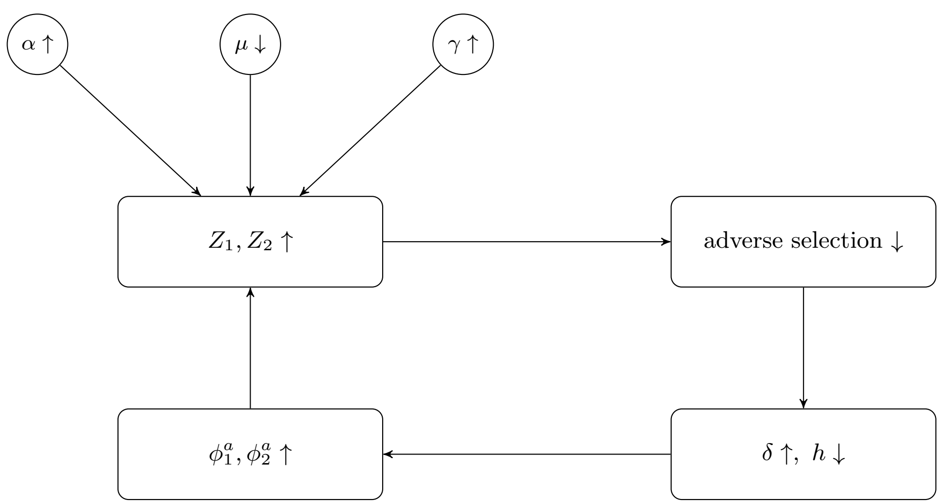
Lemma 4. *For a fixed haircut h, as γ increases, real balances of money Z_1 and Z_2 both increase.*

When the marginal utility of consumption rises, the value of money naturally increases. A higher real money balance then triggers the positive feedback loop identified in the previous section: smaller haircuts, greater pledgeability of the risky asset, and, in turn, higher asset prices.[5]

Proposition 7. *The optimal haircut is strictly decreasing and the asset price is increasing in γ.*

Figure 2 illustrates the above comparative results, focusing on the feedback loop between the tokenized money prices and the risky asset value when a deep parameter of the economy changes.

Figure 2: Comparative Statics



[5]The proof for the following proposition is similar to those in the previous section and omitted.

5.4 Tokenized Money as a Collateral Multiplier

In this subsection, we describe how tokenized money acts as a collateral multiplier to increase the funding that the entrepreneur obtains in the securities market. The key is how the money balance enters the collateral portfolio. To make the analysis transparent, we denote by $\phi \equiv \phi_{1t}^m \hat{m}$ the real value of the entrepreneur's money balance in AM-1, and we express all other quantities per unit of the risky asset ($\hat{a} = 1$).

Funding backed by the risky asset alone. When money is not pledgeable, the debt security is backed solely by the risky asset and the funding raised by issuing the debt is

$$p^N = \phi_{1t}^a + \lambda \mathbb{E}_L \min\left(\tilde{s}_t, \delta^{c,N}\right) + (1-\lambda)\mathbb{E}_H \min\left(\tilde{s}_t, \delta^{c,N}\right), \tag{27}$$

where $\delta^{c,N}$ solves (11) at equality. The money balance ϕ does not enter the debt. It is carried to Market-C and used as a medium of exchange.

Funding with tokenized money pledged separately. To isolate the collateral multiplier effect, we consider a benchmark case in which tokenized money is pledgeable but is not pooled with the risky asset. The debt is backed by the risky asset and tokenized money separately:

$$y = \min(\tilde{s} + \phi_1^a, D) + \frac{\alpha \hat{m}}{\hat{a}} \phi_1^m. \tag{28}$$

Because the money balance does not enter the pooling debt, the amount of tokenized money does not affect $\delta^{c,N}$. The total resources that the entrepreneur brings out of AM-1 are therefore the sum of two quantities determined in segmented markets,

$$F^N = \hat{a} p^N + \alpha Z_1^N. \tag{29}$$

In this formulation, a fraction $\alpha \in (0,1]$ of the money balance serves as direct collateral but does not act as a collateral multiplier. The pledgeable fraction of the dividend $\delta^{c,N}$ is the same as in the traditional fiat money case. The equilibrium real balance of money is

$$Z_2 = \frac{\beta}{\mu} Z_1 \left(1 + \alpha(z-1)\right), \quad Z_1 = Z_2 u'\left(Z_2\right). \tag{30}$$

Funding with tokenized money pooled in the portfolio. As derived in Sections 4.6 and 4.7, when a fraction $\alpha \in (0,1]$ of the money balance is pledged jointly with the risky asset, the funding raised by the debt is

$$p^T = \phi_{1t}^a + \alpha\phi + \lambda \mathbb{E}_L \min\left(\tilde{s}_t, \delta^{c,T}\right) + (1-\lambda)\mathbb{E}_H \min\left(\tilde{s}_t, \delta^{c,T}\right), \tag{31}$$

where $\delta^{c,T}$ solves (20) at equality. Because money is now part of the collateral portfolio, the funding is captured by the debt price alone,

$$F^T = \hat{a}p^T. \tag{32}$$

Comparing F^N ***and*** F^T***.*** Substituting (27) and (31) into the definitions of F^N and F^T and using the equilibrium identity $\hat{m}\phi^m_{1t} = Z_1$ with $\hat{m} = M_t$, the money contribution $\alpha\hat{m}\phi^{m,R}$ in each regime $R \in \{T, N\}$ reduces to αZ^R_1. The difference between the two funding levels is

$$F^T - F^N = \underbrace{\hat{a}\left(\phi^{a,T}_1 - \phi^{a,N}_1\right)}_{\text{asset price feedback}} + \underbrace{\hat{a}\,\Delta\mathbb{E}\min\left(\tilde{s}_t, \delta^c\right)}_{\text{pledgeable dividend expansion}} + \underbrace{\alpha\left(Z^T_1 - Z^N_1\right)}_{\text{money price adjustment}}, \tag{33}$$

where

$$\Delta\mathbb{E}\min\left(\tilde{s}_t, \delta^c\right) \equiv \lambda\mathbb{E}_L\left[\min(\tilde{s}_t, \delta^{c,T}) - \min(\tilde{s}_t, \delta^{c,N})\right] + (1-\lambda)\mathbb{E}_H\left[\min(\tilde{s}_t, \delta^{c,T}) - \min(\tilde{s}_t, \delta^{c,N})\right].$$

The three terms in (33) jointly capture the collateral multiplier effect, since the direct collateral service of money (the αZ_1 contribution) is present in both F^N and F^T. The three terms are interpreted as follows.

First, the asset price feedback is positive. By Proposition 5, the equilibrium collateral asset price is higher under tokenization, $\phi^{a,T}_1 \geq \phi^{a,N}_1$. Pooling money with the risky asset reduces adverse selection. The optimal haircut falls ($h^{*,T} \leq h^{*,N}$), and from (25) a smaller haircut raises ϕ^a_1.

Second, the pledgeable dividend expansion is also positive. The same drop in the optimal haircut raises the equilibrium debt threshold, $\delta^{c,T} \geq \delta^{c,N}$, so that a larger fraction of the risky dividend is pledged in the pooling debt. The pooled expected payment is monotone in δ^c, so $\Delta\mathbb{E}\min(\tilde{s}_t, \delta^c) \geq 0$.

Third, the money price adjustment is negative. Comparing (24) and (30), the leverage on tokenized money is $1 + \alpha(z-1)(1-h^{*,T})$ in regime T but $1 + \alpha(z-1)$ in regime N. When $h^{*,T} > 0$, the haircut on the joint collateral pool reduces the marginal value of pledged money, so $\phi^{m,T} \leq \phi^{m,N}$. The term $\alpha(Z^T_1 - Z^N_1)$ is the price that the entrepreneur pays for placing tokenized money inside the joint collateral portfolio rather than pledging it as side-collateral.

The net collateral multiplier effect is the sum of these three terms. At $h^{*,T} = 0$, the third term vanishes and pooling weakly dominates side-pledging, with strict inequality whenever the first or second term is strict. More generally, $F^T > F^N$ whenever the gains from a lower haircut and a higher asset price dominate the loss on the marginal value of money.

This decomposition also clarifies the economic role of pooling cash with the risky asset. When one looks only at the leverage on the risky asset, pooling cash raises the entrepreneur's equity cushion on the risky asset and appears unattractive. This is the negative force captured by the money price adjustment channel. In our model, however, the entrepreneur does not choose the collateral composition to maximize leverage on the risky asset. She chooses the composition to maximize the funding available to finance her productive technology. The first two channels show that pooling lowers the equilibrium haircut and raises the pledgeable threshold, and the proposition below shows that these gains dominate the third channel whenever the pooling constraint binds.

Proposition 8. *Suppose the pooling constraint binds at a strictly positive optimal haircut, $h^* > 0$. Then per-unit investment $p(\alpha)$ and per-unit output $z\,p(\alpha)$ are strictly increasing in the pledgeability α of tokenized money. In particular, both are strictly higher in the tokenized regime ($\alpha > 0$) than in the no-tokenized regime ($\alpha = 0$).*

Figure 3 illustrates the three-channel decomposition numerically. We use exponential dividend distributions with rates $l_H = 1$ and $l_L = 10$, $\lambda = 0.9$, $z = 1.05$, $\beta = 0.9$, $\mu = 1.10$, and CRRA utility $u'(c) = c^{-\sigma}$ with $\sigma = 0.5$, and we sweep the pledgeability α from 0 to 1. Panels (A) and (B) plot the three channels in (33) in levels and as a percent of F^N, respectively: the asset-price feedback (i) is the dominant positive contribution, the pledgeable-dividend expansion (ii) is positive and growing in α, while the money-price adjustment (iii) is small and negative, the cost of placing tokenized money inside the joint collateral pool. Panel (C) shows that the optimal haircut $h^{*,T}$ falls and the pledgeable threshold $\delta^{c,T}$ rises in α, both relative to the regime-N benchmarks. Panel (D) confirms $Z_1^T \leq Z_1^N$, the proximate source of channel (iii). On net, the collateral-multiplier effect is unambiguously positive across the entire range of α.

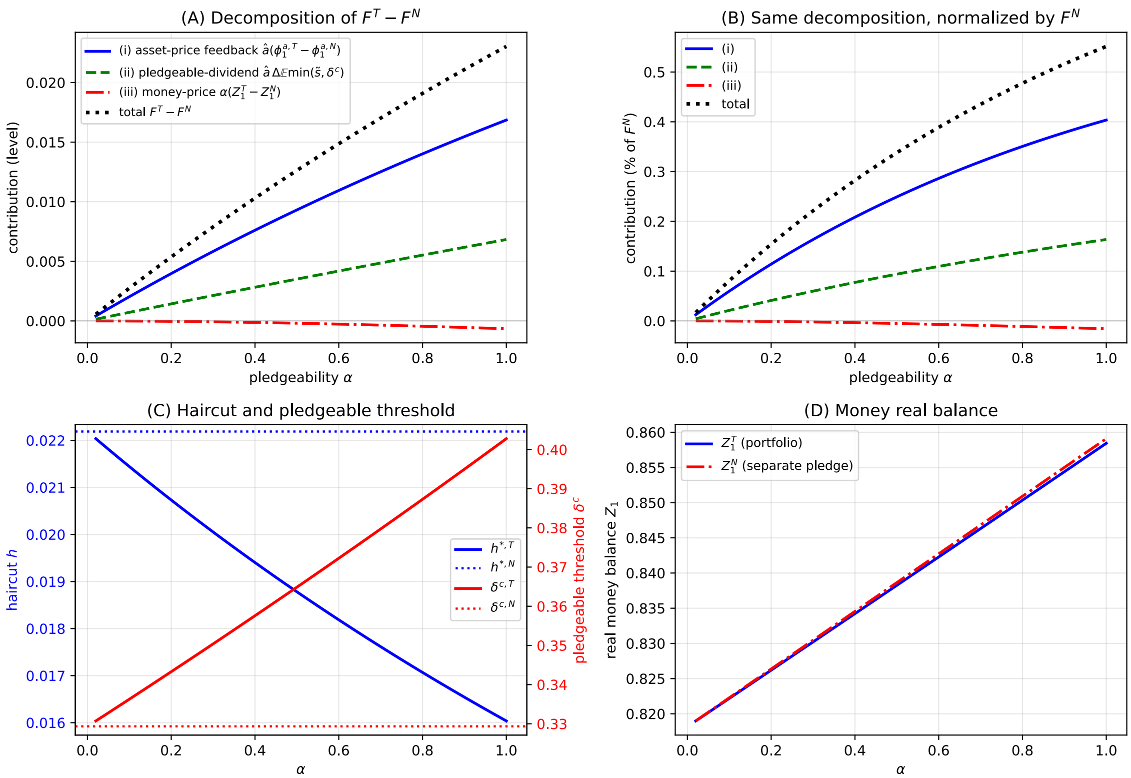
5.5 Numerical Examples

In this subsection, we present numerical examples that examine how monetary policy and the degree of information friction affect equilibrium outcomes under three values of the pledgeability parameter α. The regime in which all tokenized money is pledgeable ($\alpha = 1$) is shown by the solid line. The regime without tokenized money ($\alpha = 0$) is shown by the dash-dotted line. The intermediate case ($\alpha = 0.5$) is shown by the dashed line.

We first examine how inflation μ affects the equilibrium. Figure 4 presents the results. In the tokenized money regime, higher inflation raises the haircut on the collateral portfolio and lowers the debt face value, the real balance of money, consumption, and investment.[6] The risky asset price also

[6] Consumption is given by the real balance Z_2. Investment is the funding raised by selling the debt security, which equals

Figure 3: Three-channel decomposition of $F^T - F^N$



declines, although only mildly. That is, inflation reduces the pledgeability of the collateral portfolio, lowers money and asset prices, and dampens real economic activity.

In the no-tokenized regime, by contrast, inflation affects real balances and consumption but has no impact on the risky asset price, the haircut, the debt threshold, or investment. Consumption and securities markets are segmented. Money serves only as a medium of exchange in the consumption market and is not used as collateral in the securities market.

Under the tokenized money regime, the impact of inflation on the risky asset price, the haircut, and the debt threshold is subdued relative to its impact on real balances and consumption. Investment relies on both risky assets and tokenized money as collateral, so the risky asset price does not decline significantly as inflation rises.

Next, we examine how the probability of the low type λ affects debt face value, investment, con-

the debt price p. Output is $z\,p$, the productive technology applied to the investment. Panel (B) of the figure therefore also shows output, up to the constant $z > 1$.

sumption, the real balance of money, and asset prices. λ is a proxy for both adverse selection risk and cashflow risk. When λ is higher, the cashflow risk is larger because the asset is more likely to pay a low dividend. The relation between λ and adverse selection risk is non-monotonic: as λ approaches zero or one, there is less uncertainty about the asset type, and adverse selection risk is lower. Figure 5 presents the results.

In the tokenized money regime, the haircut on the collateral portfolio is hump-shaped in λ. It first rises and then falls, reflecting the non-monotonic effect of adverse selection. By contrast, the asset price and investment decline monotonically in λ, which reflects the increase in cashflow risk. Comparing the tokenized money regime (solid lines) with the regime without tokenized money (dash-dotted lines), we see that the debt face value and investment are uniformly higher and less sensitive to adverse selection and cashflow risk under tokenization. The risky asset price is also slightly higher under tokenization. (Panel D plots the percent deviation from the $\alpha = 0$ baseline to make this visible.) Taken together, these patterns show that tokenized money lowers information frictions and raises the pledgeable value of the risky asset for all values of λ.

6 Conclusion

This paper studies a model in which money functions both as a means of payment for consumption goods and as a safe asset that can be pledged as collateral in financial markets. We use this framework to analyze the economic consequences of tokenized money. At present, cash is used as collateral mostly in a few specialized markets such as centrally cleared derivatives, tri-party repo, and bilateral derivative contracts, where dedicated institutional arrangements make pledging cheap. Tokenization reduces the cost of pledging safe money more broadly in the economy.

In our model, the equilibrium value of tokenized money reflects three related channels. First, tokenized money provides a transaction service in the consumption goods market. Second, it offers a direct collateral service, since it can be pledged against debt used to finance productive investment. Third, when pooled with the risky asset in the collateral portfolio, tokenized money lowers adverse selection on the risky asset, which is what we call the collateral multiplier effect. This last channel generates a feedback loop between the consumption goods market and the securities market that is absent under traditional fiat money. A higher real value of tokenized money raises the pledgeable value of the risky asset and hence its price, and the rise in the asset price reinforces the demand for tokenized money as a collateral asset. To decompose the additional funding generated by pooling tokenized money with the risky asset, we compare it with a benchmark in which tokenized money is pledged separately. We identify three terms in the decomposition: an asset price feedback from reduced adverse selection, an expansion in the pledgeable dividend of the risky asset, and an offsetting reduction in the marginal value of pledged money. In our numerical examples, the first two terms dominate, so that the net collateral multiplier effect is positive.

Our comparative statics yield a set of empirically testable predictions. In the tokenized money regime, higher inflation raises the haircut on the collateral portfolio and lowers the face value of debt, the real balance of money, consumption, and investment. In the traditional fiat money regime, inflation affects real balances and consumption but does not affect the risky asset price, the haircut, or investment, because money does not enter the securities market. Under tokenization, the pass-through of inflation to financial variables is therefore a new transmission channel for monetary policy. Quantitatively, however, the risky asset price and investment are less sensitive to inflation than consumption is, so that tokenized money also acts as a collateral buffer that partially stabilizes financial variables against inflation. Stronger adverse selection depresses investment and the asset price in both regimes, but the effect is mitigated under tokenization.

Our results also have policy implications. Currently, the safe asset premium on money accrues to a narrow set of financial intermediaries that provide the infrastructure for pledging money as collateral. Tokenization makes it possible for a wide range of private providers of digital money to capture this premium by issuing tokenized private money. This creates pressure on the central bank to reassert public control over currency issuance in an increasingly digital and privately intermediated monetary system. A wholesale CBDC or insured tokenized deposits settled on a common ledger offers one way of doing so and may also help sustain the central bank's seigniorage as payments and collateral migrate to the ledger. Central banks must balance privacy, financial stability, and transition risks in designing such systems. Our analysis suggests that the safe asset and collateral properties of tokenized money are central to both monetary and financial system efficiency, and we advocate for embedding programmability and contractibility into tokenized money from the outset, so that the collateral multiplier mechanism we identify becomes operative as the tokenized monetary infrastructure matures.

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A Proofs

A.1 Proof of Proposition 1

Proof. From (15) we obtain Z_1 and Z_2. From (16) we obtain ϕ_1^a. We substitute ϕ_1^a into (11) to obtain:

$$\lambda \mathbb{E}_L \min\left(\tilde{s}_t, \delta\right) + (1-\lambda)\,\mathbb{E}_H \min\left(\tilde{s}_t, \delta\right) \leq \left(1 - \frac{h}{1-\beta\left(z\left(1-h\right)+h\right)}\right) \mathbb{E}\tilde{s}_t. \tag{A.1}$$

Note that the left side of (A.1) increases in δ and the right side of (A.1) decreases in h. At $h = 0$, (A.1) holds with equality for $\delta^c = \overline{s}$. At $h = \overline{h}$, (A.1) holds with equality for $\delta^c = 0$. Hence there exists a (unique) decreasing function $\delta^c(h) \in [0, \overline{s}]$ such that (11) holds with equality for all $h \in \left[0, \frac{1-\beta z}{1-\beta(z-1)}\right]$.

Let's now turn to the pooling condition given by (13). At $h = \overline{h}$

$$\phi_1^a = \frac{\beta}{1-\beta z}\mathbb{E}\tilde{s}_t$$

and (13) holds with strict inequality:

$$\frac{\beta}{1-\beta z}\mathbb{E}\tilde{s}_t > \frac{1-z(1-\lambda)}{z-1}E_H\left[\min(\tilde{s}_t, \delta^c(\overline{h}))\right] - \frac{z\lambda}{z-1}E_L\left[\min(\tilde{s}_t, \delta^c(\overline{h}))\right] = 0.$$

Hence, (A.1) and (13) both hold for $h \in \left[\overline{h}-\epsilon, \overline{h}\right]$ for $\epsilon > 0$ and small enough. □

A.2 Proof of Proposition 2

Proof. Recall that (11) is satisfied with equality for $\delta^c(h)$ where $h \in \left[0, \frac{1-\beta z}{1-\beta(z-1)}\right]$. At $h = 0$ (13) becomes

$$\left(\frac{z(1-\beta)}{1-\beta z}\right)\mathbb{E}\tilde{s} = \left(1 + \frac{z-1}{1-\beta z}\right)\mathbb{E}\tilde{s} \geq E_H\tilde{s}.$$

If this inequality holds, then $h^* = 0$. If this inequality is violated, the optimal haircut is given by the smallest solution to:

$$\frac{\beta(z(1-h)+h)}{1-\beta(z(1-h)+h)}\mathbb{E}\tilde{s}_t - \left[\frac{1-z(1-\lambda)}{z-1}E_H\left[\min(\tilde{s}_t, \delta^c(h))\right] - \frac{z\lambda}{z-1}E_L\left[\min(\tilde{s}_t, \delta^c(h))\right]\right] = 0.$$

Note that at $h = \overline{h}$ the left side of the equation is strictly positive and at $h = 0$ the left side is strictly negative. Therefore, a stationary equilibrium exists. □

A.3 Proof of Lemma 1

Proof. Taking the derivatives from (24) we get:

$$\frac{\partial Z_2(h)}{\partial h} = \frac{\alpha u'(Z_2(h))(z-1)}{u''(Z_2(h))(1+\alpha(z-1)(1-h))} < 0,$$

and

$$\frac{\partial Z_1(h)}{\partial h} = \frac{\partial Z_2(h)}{\partial h}\left(u'(Z_2(h)) + Z_2(h)u''(Z_2(h))\right) < 0$$

where $\left(u'(Z_2(h)) + Z_2(h)u''(Z_2(h))\right) > 0$ by assumption.

$$\begin{aligned}\frac{\partial(hZ_1(h))}{\partial h} &= Z_1(h) + h\frac{\partial Z_1(h)}{\partial h}\\ &= u'(Z_2(h))\frac{Z_2 u''(Z_2(h))(1+\alpha(z-1)) + \alpha h(z-1)u'(Z_2)}{u''(Z_2(h))(1+\alpha(z-1)(1-h))}.\end{aligned}$$

To show that the sign of the above expression is positive, we need to show:

$$Z_2(h)\,u''(Z_2)(1+\alpha(z-1))+\alpha h(z-1)\,u'(Z_2(h))<0$$

or

$$-\frac{u'(Z_2(h))}{Z_2(h)\,u''(Z_2(h))}<\frac{1+\alpha(z-1)}{\alpha h(z-1)}.$$

Since

$$\frac{z}{z-1}\leq\frac{1+\alpha(z-1)}{\alpha h(z-1)}$$

and by assumption

$$-\frac{u'(Z_2(h))}{Z_2(h)\,u''(Z_2(h))}<\frac{z}{z-1}.$$

□

A.4 Proof of Proposition 3

Proof. From (24) we obtain Z_1 and Z_2. From (25) we obtain ϕ_1^a. We substitute ϕ_1^a and $\hat{a}=1$ into (20) to obtain:

$$\lambda\mathbb{E}_L\min(\tilde{s},\delta)+(1-\lambda)\,\mathbb{E}_H\min(\tilde{s},\delta)\leq\left(1-\frac{h}{1-\beta(z(1-h)+h)}\right)\mathbb{E}\tilde{s}-h\alpha Z_1 \tag{A.2}$$

Note that the left side of (A.2) increases in δ and, since $\frac{\partial(hZ_1)}{\partial h}>0$, the right side of (A.2) decreases in h. Suppose at $\hat{h}$ right side becomes 0. At $h=0$, (A.2) holds with equality for $\delta^c=\overline{s}$. At $h=\hat{h}$, (A.2) holds with equality for $\delta^c=0$. Hence there exists a (unique) decreasing function $\delta^c(h)\in[0,\overline{s}]$ such that (11) holds with equality for all $h\in\left[0,\hat{h}\right]$.

Let's now turn to the pooling condition given by (22) where we evaluate the right side at $\delta^c(h)$. At $h=\hat{h}$, (22) holds with strict inequality. Hence, (A.2) and (22) both hold for $h\in\left[\hat{h}-\epsilon,\hat{h}\right]$ for $\epsilon>0$ and small enough. □

A.5 Proof of Proposition 4

Proof. Recall that (20) is satisfied with equality for $\delta^c(h)$ where $h\in\left[0,\hat{h}\right]$. At $h=0$ (22) becomes

$$\left(1+\frac{z-1}{1-\beta z}\right)\mathbb{E}\tilde{s}+\alpha Z_1(0)\geq\hat{a}E_H\tilde{s}.$$

If this inequality holds then $h^*=0$. If this inequality is violated then optimal haircut is given by the smallest solution to:

$$\frac{\beta(z(1-h)+h)}{1-\beta(z(1-h)+h)}\mathbb{E}\tilde{s}_t+\alpha Z_1(h)-\left[\frac{1-z(1-\lambda)}{z-1}E_H\left[\min(\tilde{s}_t,\delta^c(h))\right]-\frac{z\lambda}{z-1}E_L\left[\min(\tilde{s}_t,\delta^c(h))\right]\right]=0.$$

Note that at $h = \hat{h}$ the left side is strictly positive and at $h = 0$ the left side is strictly negative. Therefore a stationary equilibrium exists. $\square$

A.6 Proof of Proposition 5

Proof. Recall that $\delta^c(h)$ is given by the solution to:

$$(\lambda \mathbb{E}_L \min(\tilde{s}, \delta) + (1-\lambda)\mathbb{E}_H \min(\tilde{s}, \delta)) = \left(1 - \frac{h}{1-\beta(z(1-h)+h)}\right)\mathbb{E}\tilde{s} - h\alpha Z_1(h)$$

$h \in \left[0, \hat{h}\right]$. Note that $Z_1(h)$ depends on α. Both directly and through $Z_1(h)$, the solution $\delta^c(h)$ depends on α. We write $\delta^c(h;\alpha)$ to make this dependence explicit. As α increases $Z_1(h;\alpha)$ increases. Hence as α increases the right side shifts down and $\delta^c(h;\alpha)$ decreases for all $h \in \left[0, \hat{h}\right]$.

By assumption the pooling constraint binds at $h = 0$ so that:

$$\left(1 + \frac{z-1}{1-\beta z}\right)\mathbb{E}\tilde{s} + \alpha Z_1(0) < \hat{a}E_H\tilde{s}.$$

In this case $h^* > 0$ and the equilibrium value of h which is given by h^* is the smallest solution to:

$$\frac{\beta(z(1-h)+h)}{1-\beta(z(1-h)+h)}\mathbb{E}\tilde{s}_t + \alpha Z_1(h;\alpha) = \left[\frac{1-z(1-\lambda)}{z-1}E_H[\min(\tilde{s}_t, \delta^c(h;\alpha))] - \frac{z\lambda}{z-1}E_L[\min(\tilde{s}_t, \delta^c(h;\alpha))]\right]$$

The left side of the above equation is decreasing in $h \in \left[0, \hat{h}\right]$. Moreover, if α goes up, the left side shifts up.

The right side is above the left side at $h = 0$, hence it must intersect the left side from above at $h = h^*$. Therefore, at $h = h^*$ the right side must be a decreasing function in h. Since $\delta^c(h;\alpha)$ is a decreasing function of h, the right side must be increasing if viewed directly as a function of δ at $\delta = \delta^c(h^*;\mu)$. Therefore, if α goes up $\delta^c(h;\alpha)$ goes down and the right side shifts down for each $h \in \left[0, \hat{h}\right]$.

Since both the left and right sides are decreasing functions, and the left side shifts up and the right side shifts down when α goes up, the solution h^* goes down when α goes up. The statement that the asset price is increasing follows directly from (25). $\square$

A.7 Proof of Proposition 8

Proof. Per-unit investment equals the equilibrium debt price,

$$p(\alpha) = \phi_1^a(\alpha) + \alpha Z_1(\alpha) + \lambda\mathbb{E}_L \min(\tilde{s}, \delta^c(\alpha)) + (1-\lambda)\mathbb{E}_H \min(\tilde{s}, \delta^c(\alpha)).$$

Proposition 5 establishes $\partial\phi_1^a/\partial\alpha > 0$ and $\partial h^*/\partial\alpha < 0$. Its proof also shows that the equilibrium pledgeable threshold $\delta^c(h^*(\alpha);\alpha)$ is strictly increasing in α (the right side of the equilibrium equation shifts down and the left side shifts up, moving the intersection to a lower h^* and a higher δ^c). Lemma 2 gives $\partial Z_1/\partial\alpha > 0$. Every term in $p(\alpha)$ is therefore weakly increasing in α, with at least ϕ_1^a and δ^c strictly so, hence $p(\alpha)$ is strictly increasing. Output is $z\,p(\alpha)$ with $z > 1$ constant, so output inherits the strict monotonicity. □

A.8 Proof of Lemma 3

Proof. Taking the derivatives from (24) we obtain:

$$\frac{\partial Z_2}{\partial \mu} = \frac{1}{\beta\left(1+\alpha(z-1)\left(1-h\right)\right)u''\left(Z_2\right)} < 0$$

and

$$\frac{\partial Z_1}{\partial \mu} = \left(u'\left(Z_2\right) + Z_2 u''\left(Z_2\right)\right)\frac{\partial Z_2}{\partial \mu} < 0.$$

□

A.9 Proof of Proposition 6

Proof. Recall that $\delta^c(h)$ is given by the solution to:

$$\left(\lambda \mathbb{E}_L \min\left(\tilde{s},\delta\right) + \left(1-\lambda\right)\mathbb{E}_H \min\left(\tilde{s},\delta\right)\right) = \left(1 - \frac{h}{1-\beta\left(z\left(1-h\right)+h\right)}\right)\mathbb{E}\tilde{s} - h\alpha Z_1\left(h\right)$$

$h \in \left[0,\hat{h}\right]$. Through the dependence of $Z_1(h)$ on μ, the solution $\delta^c(h)$ depends on μ. We write $\delta^c(h;\mu)$ to make this dependence explicit. As μ increases $Z_1(h)$ decreases. Hence as μ increases the RHS shifts up and $\delta^c(h;\mu)$ increases for all $h \in \left[0,\hat{h}\right]$.

By assumption the pooling constraint binds at $h = 0$ so that:

$$\left(1 + \frac{z-1}{1-\beta z}\right)\mathbb{E}\tilde{s} + \alpha Z_1(0) < \hat{a}E_H\tilde{s}.$$

In this case $h^* > 0$ and the equilibrium value of h which is given by h^* is the smallest solution to:

$$\frac{\beta\left(z\left(1-h\right)+h\right)}{1-\beta\left(z\left(1-h\right)+h\right)}\mathbb{E}\tilde{s}_t + \alpha Z_1\left(h;\mu\right) = \left[\frac{1-z(1-\lambda)}{z-1}E_H\left[\min(\tilde{s}_t,\delta^c\left(h;\mu\right))\right] - \frac{z\lambda}{z-1}E_L\left[\min(\tilde{s}_t,\delta^c\left(h;\mu\right))\right]\right]$$

The left side of the above equation is decreasing in $h \in \left[0,\hat{h}\right]$. Moreover, if μ goes up, the left side shifts down.

The right side is above the left side at $h = 0$, hence it must intersect the left side from above at $h = h^*$. Therefore, at $h = h^*$, the right side must be a decreasing function in h. Since $\delta^c(h;\mu)$ is a decreasing function of h, the right side must be increasing if viewed directly as a function of δ at $\delta = \delta^c(h^*; \mu)$. Therefore, if μ goes up $\delta^c(h; \mu)$ goes up and the right shifts up for each $h \in \left[0, \hat{h}\right]$.

Since both left and right side are decreasing functions, and the left side shifts down and the right shifts up when μ goes up, the solution h^* goes up when μ goes up. The statement that the asset price is decreasing follows directly from (25). □

A.10 Proof of Lemma 4

Proof. Taking the derivatives from (24) we obtain:

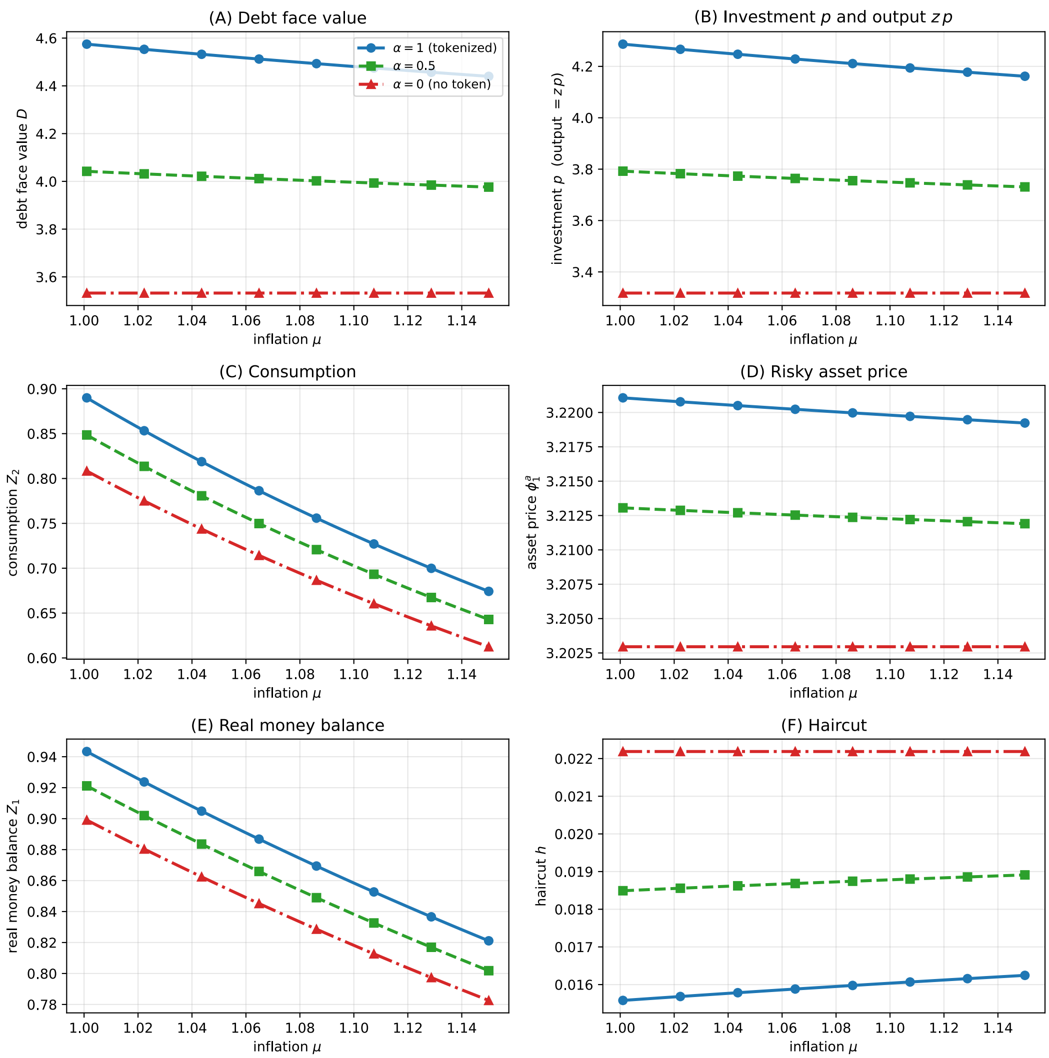
$$1 = \frac{\beta}{\mu}\gamma u'(Z_2)(1 + \alpha(z-1)(1-h))$$

$$\frac{\partial Z_2}{\partial \gamma} = -\frac{u'(Z_2)}{\gamma u''(Z_2)} > 0$$

$$\frac{\partial Z_2}{\partial \gamma} = (u'(Z_2) + Z_2 u''(Z_2))\frac{\partial Z_2}{\partial \gamma} > 0$$

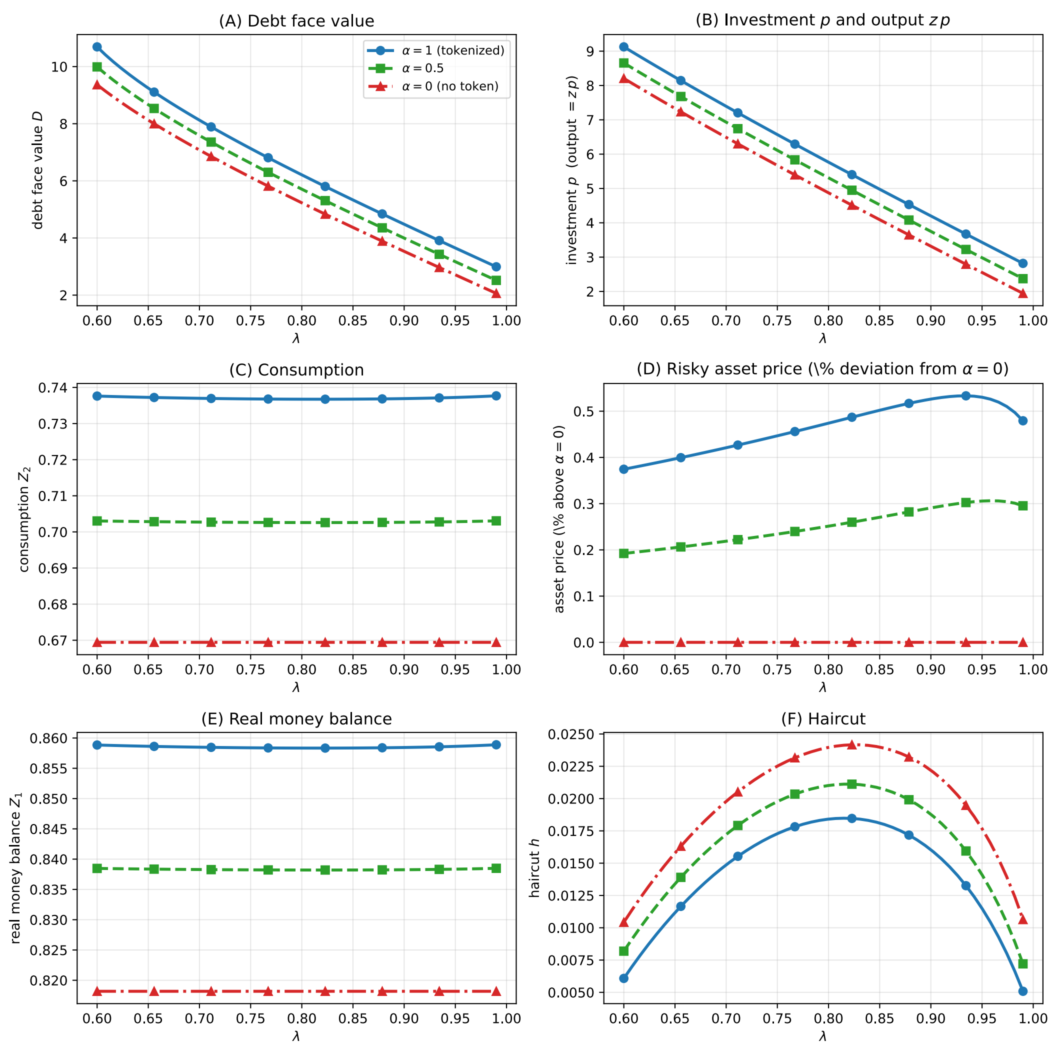
□

Figure 4: Impact of Monetary Policy



The tokenized money equilibrium quantities ($\alpha = 1$) are in the solid line, the no-tokenized money equilibrium ($\alpha = 0$) is in the dash-dotted line, and the partial tokenized money equilibrium ($\alpha = 0.5$) is in the dashed line. Parameter values: exponential dividend distributions with rates $l_H = 1$ and $l_L = 10$, $\lambda = 0.9$, $z = 1.05$, $\beta = 0.9$, and CRRA utility $u'(c) = c^{-\sigma}$ with $\sigma = 0.5$.

Figure 5: Impact of Adverse Selection



The tokenized money equilibrium quantities ($\alpha = 1$) are in the solid line, the no-tokenized money equilibrium ($\alpha = 0$) is in the dash-dotted line, and the partial tokenized money equilibrium ($\alpha = 0.5$) is in the dashed line. Parameter values: exponential dividend distributions with rates $l_H = 1$ and $l_L = 10$, $\mu = 1.10$, $z = 1.05$, $\beta = 0.9$, and CRRA utility $u'(c) = c^{-\sigma}$ with $\sigma = 0.5$.