

Why Bank Money Creation?

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Motivation

Bank money creation is an important feature of our two-tier monetary system:

- Banks create deposits (i.e., new money) through lending.
- Interbank deposit flows are settled by CB reserves.

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Bank A Balance Sheet	
<i>Assets</i>	<i>Liabilities</i>

Bank B Balance Sheet	
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Bank money creation

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This Paper:

- Compares the economic outcomes in a money creation (MC) economy to those in a loanable funds (LF) economy.
- Provides a rationale for bank money creation.

Preview of the Model and Main Results

The Model:

- Two-period, two-sector economy with risk-neutral agents.
- Households supply capital to firms in $t = 1$, goods are produced in $t = 2$.
- Bank-level moral hazard in monitoring à la Holmstrom and Tirole (1997).
- Unobservable bank-heterogeneity.

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Main Results:

- ⇒ The LF economy suffers from underinvestment in bank-dependent firms.
- ⇒ MC alleviates this problem, but implies less aggregate bank monitoring.
- ⇒ With suitable capital requirements set by the regulator, welfare in the MC economy exceeds welfare in the LF economy.

Related Literature

Practice of money and loan creation: Macleod (1866), Wicksell (1907), Hahn (1920), Keynes (1931), Schumpeter (1954), Gurley and Shaw (1960), Tobin (1963), McLeay et al. (2014), Donaldson et al. (2018).

Value of fiat money in a finite economy: Shubik and Wilson (1977), Dubey and Geanakoplos (1992, 2003, 2006), Shapley and Shubik (1977), Shubik and Tsomocos (1992), Huber et al. (2014).

Money creation in our two-tier monetary system:

- Skeie (2008), Wang (2019), Bolton et al. (2020), Parlour et al. (2020), Piazzesi et al. (2021), Wang (2021).
- **Faure and Gersbach (2021):** MC in a general equilibrium model. Equivalence of MC and LF in a frictionless economy without uncertainty.
- **Jakab and Kumhof (2019):** MC vs. LF in a DSGE model.

The Model: Macroeconomic Framework

- Two dates: $t = 1$ (investment & banking), $t = 2$ (product. & consumpt.).
- Two kinds of goods: **capital goods** (tot. amount: 1), **consumpt. goods**.
- Two separated productive sectors: frictionless sector, bank-dependent sector.

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- Two separated productive sectors: frictionless sector, bank-dependent sector.
- **Frictionless sector (FS):**
 - Access to direct financing through bonds (real price of capital: R_F).
 - Total capital deployed to the FS is denoted by K_F .
 - Production technology $g(K_F)$ with diminishing returns ($\Rightarrow R_F = g'(K_F)$).

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- **Bank-dependent sector (BS):**
 - Only indirect financing through bank loans.
 - Total capital deployed to the BS is denoted by K_B .
 - Risky production technology, with CRS sR_B , where

$$s = \begin{cases} 1 & \text{if production is successful} \\ 0 & \text{if production fails} \end{cases} .$$

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- A continuum of heterogeneous, profit-maximizing **bankers** indexed by $b \in [\underline{b}, \bar{b}]$, who take deposits and make loans:
 - each bank is endowed with e units of the capital good ($\hat{=}$ bank equity).
 - aggregate bank equity is denoted by $E (= (\bar{b} - \underline{b})e)$.
 - banks are subject to moral hazard.

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 - banks are subject to moral hazard.
- A continuum of identical **households**, who maximize $t = 2$ consumption:
 - aggregate household capital is $1 - E$.
 - households optimally allocate capital between bonds and deposits in $t = 1$.
 - parameters are such that there is an interior equilibrium.

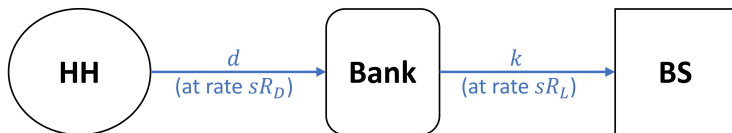
The Model: Financial Friction

Bank-level moral hazard:

- Banks face a monitoring decision $\gamma_b \in \{0, 1\}$ (no/yes).
- If bank b monitors, its firm's success probability is π
 \Rightarrow exp. production returns for the firm: πR_B .
- If bank b does not monitor, this probability is only $\pi - \Delta$, but the banker enjoys private benefits b per unit of lending.
- Asymmetric information: Only banks know their type b .
 \Rightarrow **Unobservable bank-heterogeneity.**

Banking in the LF Economy

- Each bank b takes household deposits $d_b (= d)$ at gross real rate sR_D , and
- lends $k_b (= k = e + d)$ to bank-dependent firms at gross real rate sR_L .



Equilibrium of the LF Economy

- Banks choose k so as to maximize exp. profits, s.t. HHs' incentive and participation constraint. [Details](#)

Proposition (Deficient bank-funding in the LF economy)

There is a competitive equilibrium with $\gamma_b = 1$ for all banks b . If bank equity is scarce, i.e., for

$$e < \bar{e}^{LF} := \frac{\bar{b}(1 - (g')^{-1}(\pi R_B))}{\Delta R_B(\bar{b} - \underline{b})}, \quad (1)$$

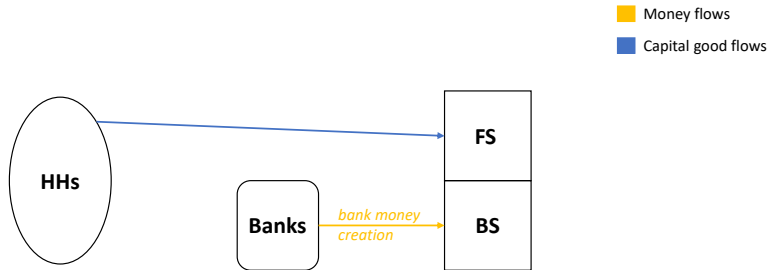
*the incentive constraint is binding. The equilibrium return R_F^{LF} satisfies $R_F^{LF} < \pi R_B$ and **there is underinvestment in the BS.***

The Model: MC Economy

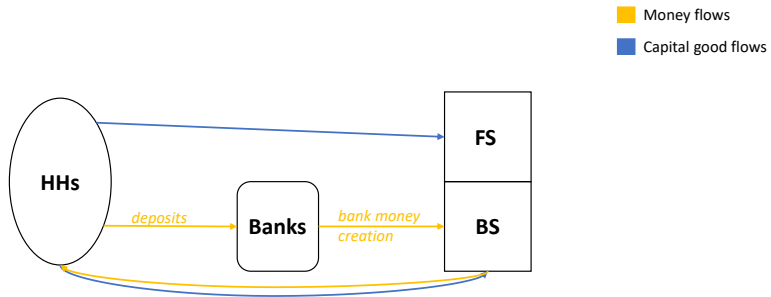
- Macroec. framework, prod. technologies, frictions as in the LF economy.
- Banking now works differently.
- Money in the model \Rightarrow **real** vs. nominal variables.
- Nominal prices of the capital and the consumption good: p_I, p_C .
- The CB policy rate for reserves is denoted by R_{CB} .
- The regulator sets a leverage constraint $\alpha (\geq 1)$ at the beginning of $t = 1$.

Timeline

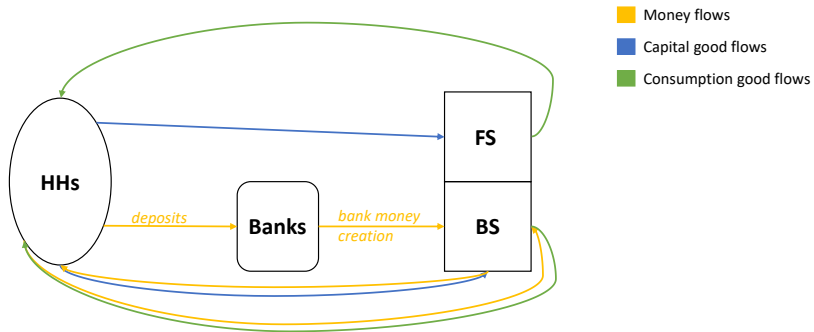
Banking in the MC Economy



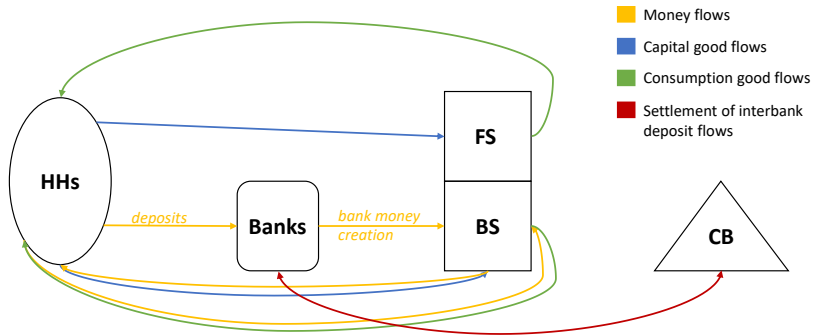
Banking in the MC Economy



Banking in the MC Economy



Banking in the MC Economy



More formally

MC Economy: Monitoring and Leverage Constraint

Banks' monitoring decision:

- Bank b monitors, if its additional exp. profits when monitoring exceed its priv. benefits when not monitoring. Yields:

$$\underbrace{\frac{l_b}{ep_I}}_{\text{bank leverage ratio}} \leq \frac{\Delta R_D}{\frac{p_C}{p_I} \mathbf{b} - \Delta(R_L - R_D)}. \quad (2)$$

Regulatory leverage constraint:

- Leverage constraint α sets an upper limit for banks' leverage ratios.
- Trade-off:** A looser leverage constraint α promotes an efficient allocation of capital, but decreases the portion of monitoring banks.

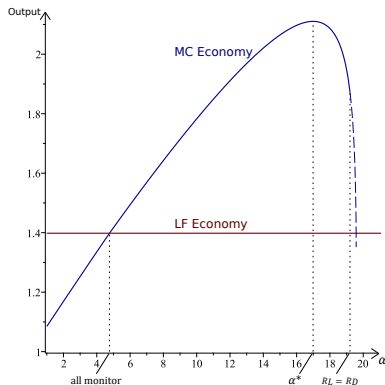
Optimal Leverage Constraint in the MC Economy

- **Trade-off:** a looser leverage constraint α promotes a more efficient allocation of capital, but decreases the average success probability of BS production.
- **Tight leverage constraint:** if α is set such that all banks monitor, the MC economy yields the same outcomes as the LF economy.
- **Optimal leverage constraint α^* :** set α such that expected aggregate output is maximized.

Why Bank Money Creation?

Proposition (MC vs. LF Economy)

*Under a weak set of sufficient conditions, the **MC economy** allows for a more efficient allocation of capital and **larger exp. output than the LF economy**.*



Conclusion

We provide a **rationale for bank money creation**, using a simple model with bank-level moral hazard:

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- **LF economy:** Allocation of capital to the BS is deficient.
- Allowing for bank **MC involves a trade-off**: it alleviates the problem of BS underinvestment, but decreases banks' monitoring activity.

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We provide a **rationale for bank money creation**, using a simple model with bank-level moral hazard:

- **LF economy:** Allocation of capital to the BS is deficient.
- Allowing for bank **MC involves a trade-off**: it alleviates the problem of BS underinvestment, but decreases banks' monitoring activity.
⇒ With a **suitable leverage constraint**, the regulator can manage this trade-off to result in **net output gains**.

Additional Material

Equilibrium of the LF Economy

- **Incentive constraint:** Given k , bank \bar{b} monitors if

$$\underbrace{\Delta [R_B k - R_D (k - e)]}_{\text{additional exp. profits when monitoring}} \geq \underbrace{\bar{b} k}_{\text{priv. benefits from not monitoring}},$$

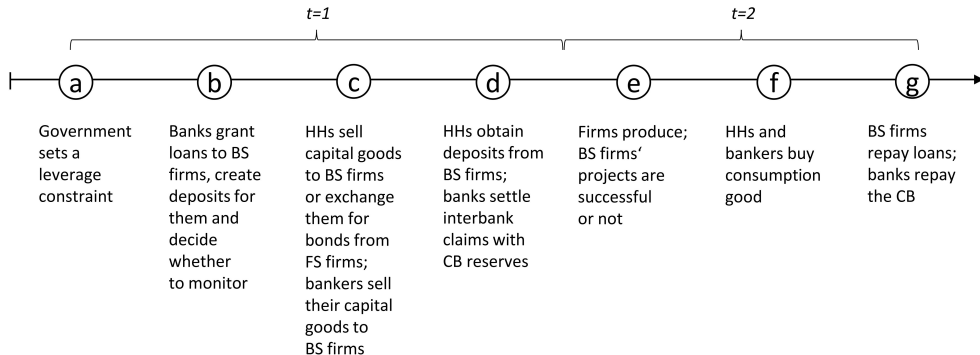
which can be rewritten as:

$$\underbrace{\frac{k}{e}}_{\text{bank leverage ratio}} \leq \frac{R_D}{R_D - R_B + \frac{\bar{b}}{\Delta}}. \quad (\text{A.1})$$

- **Participation constraint:** Households provide funding to banks, if

$$\pi R_D \geq R_F. \quad (\text{A.2})$$

MC Economy: Timeline



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Interbank transactions and CB reserves:

After firms bought the capital good from HHs, there's two possible scenarios for each bank b :

- $\underbrace{l_b}_{\text{deposit outflows}} > \underbrace{d + ep_I}_{\text{deposit inflows}} \Rightarrow \text{borrow } l_b - d - ep_I \text{ from the CB.}$
- $\underbrace{l_b}_{\text{deposit outflows}} < \underbrace{d + ep_I}_{\text{deposit inflows}} \Rightarrow \text{deposit } d + ep_I - l_b \text{ at the CB.}$

Notation:

- l_b denotes bank b 's (nominal) amount of lending.
- d denotes bank b 's (nominal) amount of HH deposits.

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Equilibrium of the MC Economy:

Definition (Competitive equilibrium)

Given the CB rate R_{CB} and a regulatory leverage constraint α , a competitive equilibrium is a BS capital to goods price ratio p_I/p_C , loan and deposit rates R_L and R_D , a FS capital price \mathbf{R}_F , individual bank monitoring decisions γ_b and lending plans l_b , such that:

- (i) given prices, l_b maximizes the expected profit of each bank b ;*
- (ii) given prices and l_b , each bank optimally decides on γ_b ;*
- (iii) given prices, firms maximize profits and HHs optimally invest;*
- (iv) aggregate demand for capital equals aggregate supply;*
- (v) capital and consumption goods markets in the BS clear;*

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Equilibrium of the MC Economy (cont'd):

HHs' investment decision:

Investing one unit of the capital good into

- the FS: yields a certain real return R_F .
- the BS: yields an expected real return $\mu[p_I R_D/p_C]$, with

$$\mu = \frac{\hat{b} - \underline{b}}{\bar{b} - \underline{b}}\pi + \frac{\bar{b} - \hat{b}}{\bar{b} - \underline{b}}(\pi - \Delta). \quad (\text{A.3})$$

\Rightarrow In interior equilibrium: $R_F = \mu R_D(p_I/p_C)$.

BS firms earn zero profits and BS market clearing:

- Yields $K_B = L_B/p_I$ and $R_B = R_L(p_I/p_C)$.

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Equilibrium of the MC Economy (cont'd): Banks' lending decision:

$$l_b = l = \alpha e p_I. \quad (\text{A.4})$$

\Rightarrow It follows that:

$$\begin{aligned} L_B &= \alpha \mathbf{E} p_I, \\ \mathbf{K}_B &= \alpha \mathbf{E}, \\ \mathbf{R}_F &= g'(1 - \alpha \mathbf{E}). \end{aligned} \quad (\text{A.5})$$

Threshold value \hat{b} :

$$\hat{b} = \Delta \mathbf{R}_B - \frac{p_I}{p_C} \left(1 - \frac{1}{\alpha}\right) \Delta R_{CB}. \quad (\text{A.6})$$

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Equilibrium of the MC Economy (cont'd):

Equilibrium BS price ratio:

Solving

$$\mathbf{R}_F = \mu \frac{p_I}{p_C} R_{CB} \quad (\text{A.7})$$

for p_I/p_C , where \mathbf{R}_F is given by (11), μ is given by (9) and $\hat{\mathbf{b}}$ is given by (12), yields

$$\frac{p_I}{p_C} = \frac{\mu_1 - \sqrt{\mu_1^2 - 4\mathbf{R}_F \frac{\Delta^2}{\bar{\mathbf{b}} - \underline{\mathbf{b}}} \left(1 - \frac{1}{\alpha}\right)}}{2R_{CB} \frac{\Delta^2}{\bar{\mathbf{b}} - \underline{\mathbf{b}}} \left(1 - \frac{1}{\alpha}\right)}, \quad (\text{A.8})$$

with

$$\mu_1 = \pi - \frac{\bar{\mathbf{b}} - \Delta \mathbf{R}_B}{\bar{\mathbf{b}} - \underline{\mathbf{b}}} \Delta. \quad (\text{A.9})$$

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