The Unintended Consequences of Ample Liquidity

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"The costs of abundant reserve systems take considerable time to appear, are likely to grow and tend to be less visible . . . The central bank has taken over much of the intermediation in the overnight interbank market . . . The abundant reserve system kills the overnight interbank market."

Claudio Borio, Head of the Bank of International Settlements Monetary and Economic Department, 2023

Summary

- Most central banks now saturate reserve markets
- The main concern expressed so far about this new paradigm has been the risk of inflation bouts as excess reserves become loans
- But excess reserves also suppress the price signal embedded in bank liquidity markets

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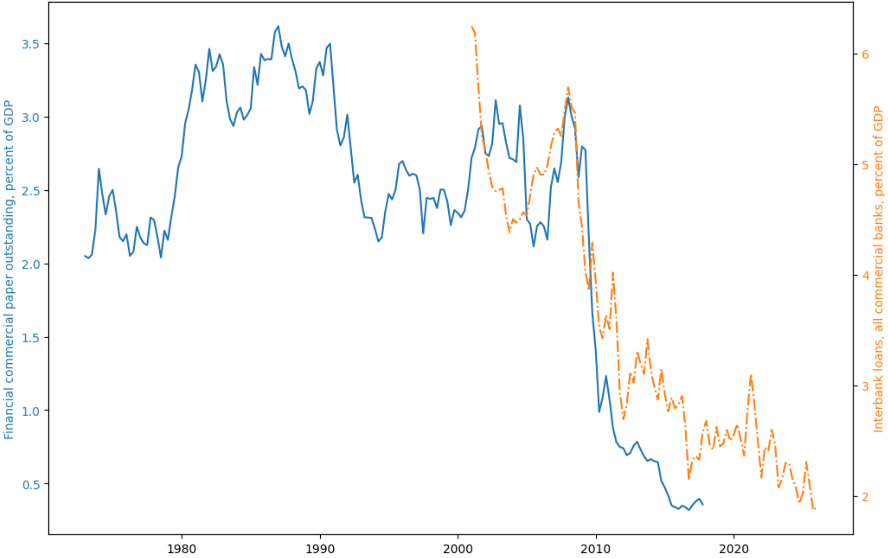
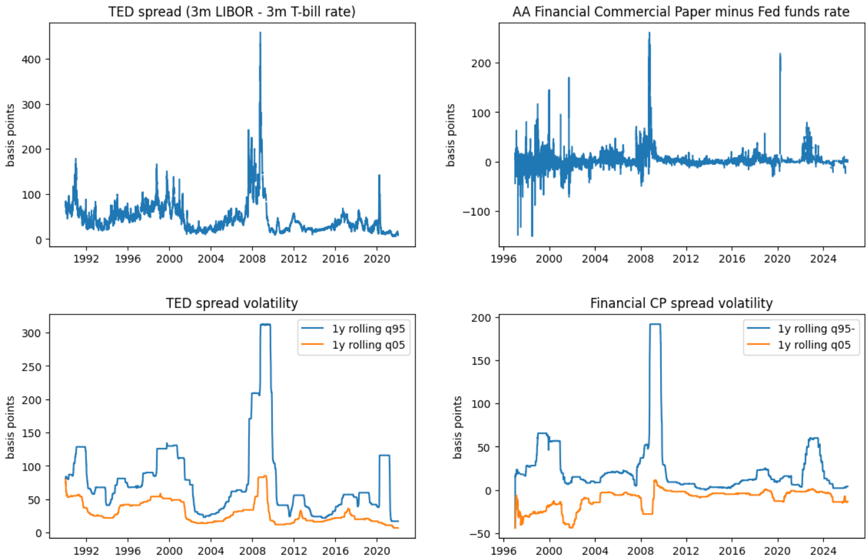
- The main concern expressed so far about this new paradigm has been the risk of inflation bouts as excess reserves become loans
- But excess reserves also suppress the price signal embedded in bank liquidity markets
- I make the case that this can result lower average loan formation, lower investment, lower output, deeper recessions, and less risk sharing ...
- ...by killing a critical canary in the landmine and preventing banks from taking evasive maneuvers when credit conditions worsen

Traditional sources of liquidity for banks



Liquidity spreads



Literature

- Canonical models of bank liquidity shocks: Poole (1968) and Diamond and Dybvig (1983)
- Cost-benefit of ample reserve frameworks: Woodford (2000), Ennis and Kiester (2008), Keister and McAndrews (2008), Afonso et al. (2020), Borio (2023) . . .
- Radner equilibria: Radner (1979), Sun, Wu, and Yannelis (2012) . . .

A model of bank liquidity shocks

- $t \in \{0, 1, 2\}$
- Continuum of locations each populated by one bank and a mass one of borrowers
- Banks are risk-neutral and endowed with a mass K of capital, any part of which they can store at a net return of zero

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- $t \in \{0, 1, 2\}$
- Continuum of locations each populated by one bank and a mass one of borrowers
- Banks are risk-neutral and endowed with a mass K of capital, any part of which they can store at a net return of zero
- Borrowers transform $k \geq 0$ into Ak^α at $t = 2$ with probability $p > 0$, or get $w > 0$ at $t = 1$
- Capital can be divested to safe storage at $t = 1$ at a rate of $\delta \in [0, 1]$
- Borrowers value consumption at date 1 only with probability ϕ, otherwise they are indifferent between consuming early or late
- They order consumption profiles $(c^E, c_1^L, \bar{c}_2^L, \underline{c}_2^L)$ according to

$$\phi \ln c^E + (1 - \phi) \ln \left(c_1^L + p\bar{c}_2^L + (1 - p)\underline{c}_2^L\right)$$

Loan contracts

At each location, the bank offers each borrower a contract $(k, s, c^E, c_1^L, c_2^L)$ that satisfies:

$$\begin{aligned}
s &\leq k \\
\phi(c^E + c_1^L) &\leq K - k \\
c_2^L &\leq A\,(k - s)^{\alpha} \\
\phi \ln c^E + (1 - \phi) \ln \left(c_1^L + p c_2^L\right) &\geq \ln w
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The bank's payoff is

$$Ap(k - s)^\alpha + (K - k) + s\delta - \phi c^E - (1 - \phi)(c_1^L + p c_2^L).$$

First best contract

Let $k^* = \arg\max_k Apk^\alpha + K - k = (p\alpha A)^{\frac{1}{1-\alpha}}$.

Lemma

If $\phi w \leq K - k^*$ then the bank offers $c_E = pc_2^L = w$. Otherwise then the bank sets $k < k^*$ and cannot offer full insurance. Finally, $s = 0$ at all optimal contracts.

Bank liquidity markets

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- If $\bar{\phi} w < K - k^*$ then bank liquidity markets with non-bank supply $S(r) \geq 0$ also play an essential role
- Let $b(\phi, r)$ be the amount of liquidity banks borrow or lend at $t = 1$ when their arrival rate is $\phi \in [0, 1]$ and the rate is r
- Equilibrium in liquidity markets requires

$$\int b(\phi, r) f(\phi) d\phi \leq S(r),$$

with equality if $r > 0$.

Optimal bank policies (1)

Banks maximize:

$$\int_0^1 \left[\left(Ap\left(k - s(\phi)\right)^{\alpha} + (K - k) + s(\phi)\delta - \phi c^E(\phi) - b(\phi)r - (1-\phi)pc^L(\phi)\right)\right] f(\phi)d\phi$$

subject to, for all $\phi \in [0, 1]$:

$$\begin{aligned}
k &\leq K && (1)\\
\int_0^1 \left[\phi \ln c^E(\phi) + (1-\phi)\ln\left(pc^L(\phi)\right)\right] f(\phi)d\phi &\geq \ln w && (2)\\
\phi c^E(\phi) &\leq K - k + b(\phi) && (3)\\
c^L(\phi) &\leq A\left(k - s(\phi)\right)^{\alpha} && (4)\\
s(\phi) &\leq k && (5)\\
c^E(\phi) &\leq pc^L(\phi) && (6)
\end{aligned}$$

Optimal bank policies (2)

Proposition

Optimal bank policies satisfy

$$k(r) = \min\left\{\left(\frac{Ap\alpha}{1+r}\right)^{\frac{1}{1-\alpha}}, K\right\}$$

and, for almost all $\phi \in [0,1]$,

1. $c^E(\phi, r) = \frac{\lambda}{(1+r)}$,
2. $c^L(\phi, r) = \min\left\{\frac{\lambda}{p}, Ak(r)^\alpha\right\}$,
3. $s(\phi, r) = 0$,
4. $b(\phi, r) = \frac{\phi\lambda}{1+r} + k(r) - K$.

Private information (1)

- A fraction $\eta > 0$ of borrowers whose project is bad receives a perfectly informative signal of project quality immediately after capital is installed
- The arrival rate of liquidity shocks is now

$$\hat{\phi} \equiv \phi + (1-\phi)\eta(1-p)$$

with the corresponding change of measure

$$\hat{f}(\hat{\phi}|p) \equiv f\left(\frac{\hat{\phi}-\eta(1-p)}{1-\eta(1-p)}\right),$$

for all $\hat{\phi} \in [\eta(1-p), 1]$.

- The average success rate for borrowers who do not receive the signal is:

$$\hat{p} = \frac{p}{p+(1-p)(1-\eta)} > p.$$

Private information (2)

- The borrower's participation constraint becomes:

$$\int_0^1 \left[\hat{\phi} \ln c^E(\hat{\phi}) + (1-\hat{\phi}) \ln\left(\hat{p} c^L(\hat{\phi})\right)\right] \hat{f}(\hat{\phi}|p) d\hat{\phi} \quad \geq \quad \ln w$$

- The bank's objective function becomes:

$$\int_0^1 \left(\hat{A}\hat{p}\left(k - s(\hat{\phi})\right)^{\alpha} + (K-k) + s(\hat{\phi})\delta - b(\hat{\phi})r - \hat{\phi}c^E(\hat{\phi}) - (1-\hat{\phi})\hat{p}c^L(\hat{\phi})\right) \hat{f}(\hat{\phi}|p) d\hat{\phi}$$

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- Feasibility is the same as before with hats
- Pure relabeling except that adding private information causes the cost of liquidity to go up hence output/investment/loan volume to go down

Aggregate shocks

- Assume p is now drawn from some known distribution ν
- Banks get two signals about p
  1. arrival rates
  2. the cost of liquidity
- A Radner (full communication) equilibrium is one in which the mapping from p to r is one-to-one
- I provide general conditions under which Radner equilibria exist

Evasive maneuvers at $t = 1$ in FCE

- Define
$$H(k, p) = \max_{s \in [0,k]} Ap(k - s)^\alpha + s\delta,$$
and
$$s(r) = \arg \max_{s \in [0,k]} Ap(r)(k - s)^\alpha + s\delta.$$
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- H is concave in k but convex in p (Hotelling's lemma)
- Under mild conditions,
$$\int_{r_L}^{r_H} H_1(k,p(r))h(r)dr \leq \int_{r_L}^{r_H} (1+r)h(r)dr,$$
with equality if $k < K$;

Ample liquidity

- Introduce an agent that creates/withdraws liquidity to support $r^* \geq 0$
- Now banks must infer aggregate conditions from arrival rates:

$$g(p|\hat{\phi}) \propto \nu(p)\hat{f}\left(\hat{\phi}|p\right)$$

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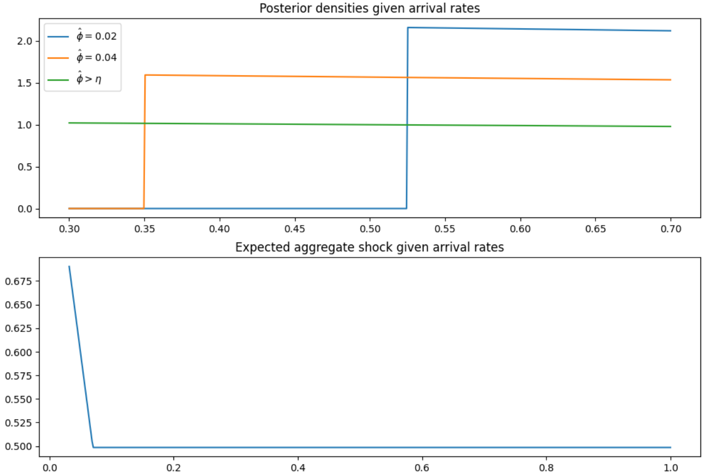
Proposition

Provided η is small enough, capital formation and average output fall when an ample framework is implemented at a rate r^* as long as

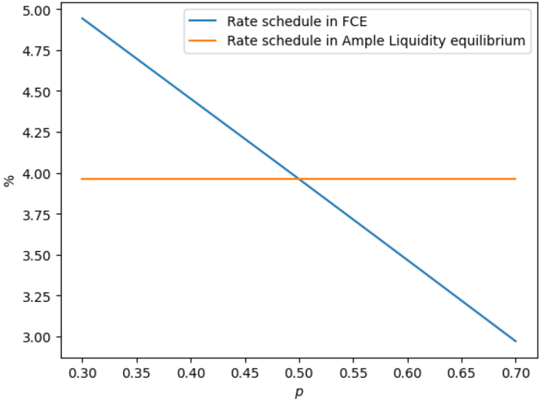
$$r^* \geq \int_{r_L}^{r_H} (1 + r)h(r)dr.$$

The inference step

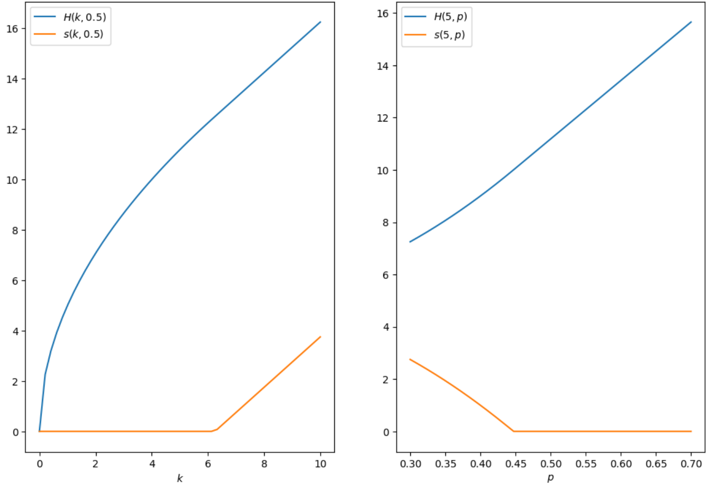


Distribution ν *is uniform on* $[p_L, p_H] = [0.3, 0.7]$*, f of is uniform on* $[0, 1]$*,* $\eta = 10\%$

Aggregate shocks and liquidity cost

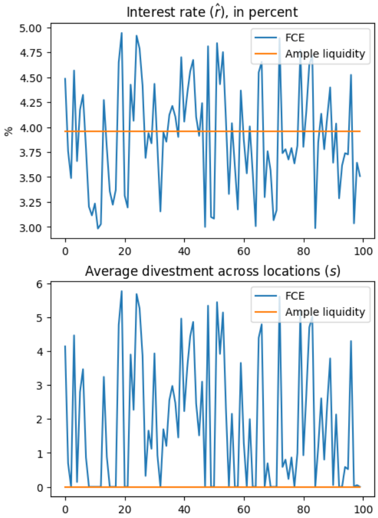


Evasive maneuvers



Notes: $A = 10$, $\alpha = 0.5$, $\delta = 1$. *The left-hand panel sets* $p = 0.5$, *the right-hand panel sets* $k = 5$.

The unintended consequences of ample liquidity



Summary

- Disrupting the price signal contained in bank liquidity markets lowers economic activity and can magnify the effect of aggregate shock
- The new monetary framework has obvious operational advantages ...
- ...but at costs that demand to be measured