Central Bank Digital Currency and Flight to Safety

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Key Ideas I

- Potential benefits of the introduction of central bank digital currency (CBDC) could come from its usefulness in online retail payments and in wholesale payments.

- But the attractions of CBDC as a means of payment also make it a convenient safe harbor in times of financial stress.
- Possible that CBDC could then engender financial instability, in that it encourages flight to safety.
- Develop a model of means of payment and banking panics to evaluate this claim.

Key Ideas II

- Conventional narrative on retail banking panics:
  - Financial crisis starts with some financial institutions entering a state of potential insolvency.
  - Small retail depositors are poorly informed concerning which financial institutions are potential insolvent.
  - If the perceived problem is significant enough, depositors execute indiscriminate large-scale withdrawals of currency from banks.
  - Central bank has better information – can issue more currency to finance lending to illiquid but solvent banks.
  - Problem: disruption in retail payments (even with central bank intervention) – currency not a perfect substitute for bank deposits.
    - This implies welfare losses from the panic, but it also discourages depositors from panicking in the first place.
- Question: If we substitute CBDC for physical currency, what happens then?
  - Less disruption from a panic, but panic is encouraged.

Model I

- Structure starts with Rocheteau/Wright (2005), and adds banks, central bank, and ingredients that can generate banking panics.
- $t = 0, 1, 2, ...$, and each period has 2 subperiods, CM followed by DM.
- Agents:
  - Continuum of *buyers* with unit mass:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[-H_t + u(x_t)\right], \tag{1}$$

  - Continuum of *sellers* with unit mass:

$$E_0 \sum_{t=0}^{\infty} \beta^t [X_t - h_t], \tag{2}$$

  - Continuum of *banks* with potentially infinite mass, but there is costly entry, so banks can be inactive:

$$E_0 \sum_{t=0}^{\infty} \beta^t [X_t - H_t] \tag{3}$$

Model II

- Production: one-for-one conversion of labor supply into perishable consumption goods in *CM* and *DM*. Buyers cannot produce in *DM*, sellers cannot produce in *CM*.
- Everyone together in *CM*; Random bilateral matching between buyers and sellers in *DM*.
- Histories of buyers not known in *DM*, active banks' histories part of public record.
- Consolidated government budget constraints:

$$c_0 + m_0 + b_0 = \tau_0, \tag{4}$$

$$c_t + m_t + b_t = \frac{c_{t-1} + R_t^m m_{t-1} + R_t^b b_{t-1}}{\pi_t} + \tau_t. \tag{5}$$

Fiscal policy rule:

$$w_t = c_t + m_t + b_t. \tag{6}$$

Banking

- In each CM, a bank can become active at a cost γ per depositor.
- $\sigma_t \epsilon \{G, B\}$ is a sunspot variable, realized in the CM of period t.
  - σ_t is an i.i.d. random variable, with $\Pr[\sigma_t = G] = 1 - \delta$, and $\Pr[\sigma_t = B] = \delta$
  - If $\sigma_t = G$, then all banks active in $t-1$ will continue to be active in period t.
  - If $\sigma_t = B$, then fraction α of banks active in period $t-1$ will become inactive in period t. A self-fulfilling fall in the bank's franchise value to zero, and bank will default on its debts.
- Timing in the CM.
  - Debts settled from previous period. Production/consumption takes place and bank contracts written.
  - σ_{t+1} observed by buyers, then withdrawal from banks occurs. Central bank knows which banks will fail, buyers do not.
- In DM, sellers know which banks are insolvent, and will not accept claims on those banks.

DM Transactions

- Probability ρ that seller in a buyer/seller match accepts only physical currency or CBDC.
- Probability $1 - \rho$ that seller accepts only a claim on a bank or CBDC.
- Buyer in a buyer/seller match makes a take-it-or-leave-it offer.
- Buyer knows what kind of seller he or she will meet at the end of the *CM*, after observing σ_{t+1}. Type is private information to buyer.

Approach

- Two regimes:
  - Physical currency, no CBDC issue.
  - Central bank withdraws physical currency, replaces it with CBDC.
- Alternative crisis intervention (on observing $\sigma_{t+1} = B$).
  - No intervention.
  - Central bank lending to solvent banks.
  - Emergency open market operations.

Physical Currency, Equilibrium with No Banking Panics

Bank's problem:

$$\max_{k_t, c_t, d_t} \left\{ -k_t + \rho u\left(\frac{\beta c_t}{\rho \pi_{t+1}}\right) + (1-\rho)(1-\alpha\delta) u\left(\beta d_t\right) \right\}$$

subject to

$$v_t = k_t - c_t + \beta(1-\alpha\delta)\left[-(1-\rho)d_t + v_{t+1}\right] \geq \bar{v}$$

$$-(1-\rho)d_t + v_{t+1} \geq 0.$$

In a stationary equilibrium,

$$\frac{c}{\rho R^b} \leq (1-\alpha)u(x^*)$$

and

$$v = \gamma$$

γ needs to be high enough to generate right incentives for the bank, low enough that buyers do not defect to using only currency in payments.

Physical Currency, Equilibrium with Banking Panics

- Expected utility of a depositor

$$
\begin{aligned}
& -k_t + \delta\left[\rho u\left(\frac{\beta c_t}{\pi_{t+1}}\right) + (1-\rho)\frac{\beta c_t}{\pi_{t+1}}\right] \\
+(1-\delta) & \left[\begin{array}{c} \rho \min\left[u(x^*), u(\frac{\beta c_t}{\rho \pi_{t+1}})\right] \\ +\rho \max\left(0, -x^* + \frac{\beta c_t}{\rho \pi_{t+1}}\right) + (1-\rho) u\left(\beta d_t\right) \end{array}\right]
\end{aligned}
$$

- All depositors wish to withdraw in a panic:

$$
\frac{c}{R^b} \geq (1-\alpha) u\left(x^*\right) \tag{7}
$$

Results: Physical Currency

- $x^* < (1-\alpha)u(x^*)$ implies banking panic equilibria do not exist. Equilibrium with no panics exists for all $R^b \geq 1$. Standard Friedman rule case.
- $x^* \geq (1-\alpha)u(x^*)$ implies banking panic equilibrium exists for low R^b, equilibrium with no panics for high R^b. No multiple equilibria.
  - May be efficient to have R^b high and no panics.
  - May be be efficient to have $R^b = 1$ and panics.
- Central bank crisis lending – does not matter at the optimum, if Friedman rule is optimal, but can imply multiple equilibria, as it can encourage panics.
- Open market operations in a panic – no improvement if Friedman rule is optimal, but worse than crisis lending in encouraging panics.

Results: CBDC

- Banks offer deposit contracts allowing "withdrawal" of CBDC on demand.
- But CBDC can be used in all transactions in the *DM*, and bears interest.
- For monetary policy, what matters is $R = \frac{R^b}{R^m}$.
- Without central bank crisis intervention, qualitatively similar to physical currency world – banking panics when R low, no panics when R high.
- Sense in which CBDC encourages panics relative to physical currency (safer harbor), but panics are less disruptive. Banking panic equilibria may dominate.
- Central bank crisis lending: Panic equliibrium exists for all $R \geq 1$, so multiple equilibria. Conventional policy cannot eliminate panics, even if that is desirable.
- Open market operations in a crisis: Banking panic equilibrium superior, but multiple equilibria.

Conclusion

- Different approach to analyzing banking panics: Self-fulfilling drop in confidence in banking system propels insolvency, which can induce a panic.
- CBDC can encourage panics, but with CBDC panics are less disruptive – so an economy that experiences banking panics may perform better than one that does not.
- Central bank crisis intervention – lending to illiquid but solvent banks or open market operations – can be beneficial, but can imply multiple equilibria.