Assessing the Impact of Central Bank Digital Currency on Private Banks

David Andolfatto

*Federal Reserve Bank of St. Louis*

CEU Budapest
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Introduction

- Growing interest in cryptocurrencies has resurrected an old debate concerning merit of a public utility banking service.


- Central Bank Digital Currency (CBDC) modern-day equivalent to Postal Savings.
Mixed Feelings

- Ricks, Crawford and Menand (2018) emphasize benefits.
  - Increased financial inclusion, enhanced financial stability, improved monetary transmission mechanism.

- Cecchetti and Schoenholtz (2017) emphasize costs.
  - Inefficient service, reduced financial stability, expanded role for state banking.

- Theoretical/empirical support?
Theoretical literature

- Barrdear and Kumhof (2016) a rich (complicated) DSGE model.
  - Introducing CBDC via open-market operation stimulates economic activity, banks benefit.

- Keister and Sanches (2018) use tractable DGE model with financially constrained “banks.”
  - Interest-bearing CBDC improves efficiency via “Friedman rule” logic.
  - Potentially harms financially constrained banks by raising funding costs.
Environment

- Version of Diamond (1965) OLG model.

- Constant population, so equal mass of young and old.

- Individuals are born either as workers or firms (equal mass of each type).

- Young workers endowed with $y \geq 0$ distributed according to c.d.f. $G(y)$.

- Young firms endowed with project, $k_t$ invested at $t$ yields $F(k_t)$ at $t + 1$. 
Environment

- Young have linear preferences defined over future consumption (wealth maximizers).

- Aggregate real saving = young worker income \( y \equiv \int ydG(y) \).

- Welfare-improving trading pattern entails young workers saving \( y \) to finance young firm capital expenditure \( k \) and (potentially) old worker consumption.
Government Policy

- Government makes money transfers $Z_t$ and collects taxes $T_t$ (lump-sum); makes no purchases ($G_t = 0$).

- Primary deficit $Z_t - T_t$ financed entirely with one-period, risk-free, nominal debt $D_t$.

- Debt consists of currency, CBDC, and bonds: $D_t = C_t + M_t + B_t$.

- Let $R^C_t$, $R^M_t$, $R^B_t$ denote gross nominal yields on $C$, $M$, $B$, respectively (Assume $R^C_t = 1$).
Government Policy

- Flow budget constraint

\[ Z_t + (R_{t-1}^B - 1)B_{t-1} + (R_{t-1}^M - 1)M_{t-1} = T_t + (D_t - D_{t-1}) \]

- Assume

\[ T_t = (R_{t-1}^B - 1)B_{t-1} + (R_{t-1}^M - 1)M_{t-1} \]
\[ Z_t = D_t - D_{t-1} \]

- Assume \( D_t = \mu D_{t-1} \) with \( D_0 > 0 \) endowed to initial old generation.

- \( Z_t \) transferred to workers, \( T_t \) applied to firms (not important).

- Assume \( T_t = (R_{t-1}^B - 1)B_{t-1} + (R_{t-1}^M - 1)M_{t-1} \)
Market Structure and Timing

- All debt, apart from cash, is intermediated by banks (central and private).

- Central and private banks share same RTGS payment system.

- Young firms + workers pay fixed utility cost $\phi$ to access banking system.

- Unbanked individuals must resort to cash; banked individuals can borrow and use debit cards.

- Bank deposits made redeemable for cash on demand at par.
Market Structure and Timing

- Old workers enter $t$ with money (cash + deposits) they worked for in $t - 1$.

- Old workers with deposits earn interest $R_{t-1}^D$.

- All old workers receive transfer $Z_t$ (check or direct deposit).

- Old workers spend all their money on goods and services, price-level $p_t$.

- Old firms enter $t$ with bank debt, which they repay with interest $R_{t-1}^L$. 
Market Structure and Timing

- Young firms enter $t$ w/ investment, financed w/ bank loan at interest $R^L_t$.

- Banks create money (deposits) in the act of lending.

- Young workers enter $t$ and choose to access banking system, cost $\phi$.

- Young firms spend their deposits on young labor (cash + debit).

- Deposits earn interest $R^D_t$ (or $R^M_t$ if CBDC); Carrying real cash balance $c$ entails utility cost $(1 - \theta)c$. 
Decision Making: Firms

- Young firm chooses $k$ to maximize future profit
  \[
  \max_k F(k) - (R^L / \Pi)k - \tau
  \]

- Solution is investment demand function $k(r^L)$, where $r^L \equiv R^L / \Pi$.

- Firm wants to borrow $p_t k(r^L)$ dollars, which bank creates and deposits in their bank accounts.

- Firm uses money to purchase labor $k(r^L)$ from workers (banked workers paid via electronic transfer, unbanked workers paid with cash).
Decision Making: Workers

- Type y worker sells y units for $p_t y$ dollars at $t$.

- Let $R \equiv \max\{R^D, R^M\}$.

- Banked workers pay bank-access cost $p_t \phi$ dollars at $t$, earn $R p_t y$ at $t + 1$.

- Unbanked workers earn $p_t \theta y$ at $t + 1$.

- So cost-benefit compares $\theta y$ to $R y - \phi$. 
Decision Making: Workers

- Solution is for all workers with $y \geq \hat{y}(R)$ to access banking system and all workers with $y < \hat{y}(R)$ to remain unbanked, where

\[
\hat{y}(R) = \left(\frac{\phi}{R - \theta}\right)
\]

with $\hat{y}(R)$ decreasing in $R$.

- Fraction of unbanked $G(\hat{y}(R))$ decreasing in $R$.

- Demand for real currency balances $c(R) = \int_0^{\hat{y}(R)} ydG(y)$.

- Demand for real deposits $q(R) = y - c(R)$, increasing in $R$. 
Decision Making: Banks

- Choose reserves $B_t$ and loans $p_t k(R^L / \Pi)$ financed via deposits $p_t \hat{q}(R^D)$ subject to balance sheet constraint,

\[ B_t + p_t k(R^L / \Pi) = p_t \hat{q}(R^D, R^M) \]

to maximize future value

\[ V_{t+1} = R^B B_t + R^L p_t k(R^L / \Pi) - R^D p_t \hat{q}(R^D, R^M) \]

where $\hat{q}(R^D, R^M) = q(R^D)$ if $R^D \leq R^M$ and $\hat{q}(R^D, R^M) = 0$ otherwise.

- Combining terms...

\[ V_{t+1}/p_t = \left[ R^L - R^B \right] k(R^L / \Pi) + \left[ R^B - R^D \right] \hat{q}(R^D, R^M) \]
Decision Making: Banks

\[ V_{t+1}/p_t = \left[ R^L - R^B \right] k(R^L/\Pi) + \left[ R^B - R^D \right] \hat{q}(R^D, R^M) \]

- Profit-maximizing \( R^D \) depends on \( R^B \) (mark-down) and possibly \( R^M \).

- Profit-maximizing \( R^L \) depends only on \( R^B \) (mark-up).

**Proposition 1** If banks can borrow reserves at IOR rate \( R^B \), then CBDC will have no effect on bank lending activity (unless \( R^M \) is tied to \( R^B \) via policy).

**Proposition 2** Banks will match CBDC rate for any \( R^D = R^M \leq R^B \).
Stationary Equilibrium

- I’ve already imposed a lot of stationarity.

- To close model, need to describe price-level determination.
  \[ D_t/p_t + k(R^L/\Pi) = y \]  
  (Price-Level)

- FODE in price-level with stationary solution \( \Pi = \mu \).
  \[ M_{1t} = C_t + p_t k(R^L/\mu) \]  
  (M1)

  where \( C_t = p_t c(R) \) currency-in-circulation.

- Note \( R \equiv \max\{R^D, R^M\} \) affects CIC and M1, but not price-level.
Stationary Equilibrium

• Financing the interest expense of the debt

\[ \tau = \frac{1}{\mu} \left[ (R^B - 1)b + (R^M - 1)(q - \hat{q}) \right] \]

• If \( R^M \leq R^B \), then \( b > 0 \) and \( \hat{q} = q \).

• If \( R^M > R^B \), then \( b < 0 \) and \( \hat{q} = 0 \).

• Financing transfer payments

\[ z = \left[ 1 - \frac{1}{\mu} \right] \left( \frac{D_t}{p_t} \right) \]
Central Bank Digital Currency

- Both critics and proponents suggest CBDC would require “large” central bank intervention. But would it?

- I assume that all banks (central and private) utilize the same RTGS payments infrastructure (e.g., TARGET2 in Europe).

- If CBDC option compels banks to compete for deposits, actual CBDC take-up rate could remain small (possibly non-existent).

- But suppose, hypothetically, that CBDC option is so attractive as to drain banks of all deposits...
Central Bank Digital Currency

- Is this a serious problem?

- No, banks can still create deposits (via lending) with opportunity cost determined by IOR (not CBDC).

- As deposits flow to CB, banks can borrow reserves to cover the outflows. (If CB does not lend reserves, interbank rate would likely rise in reality.)

- Bank profits would decline as they no longer make the spread on deposit rate vs. IOR rate.

- There may be some fiscal consequences, but nothing major.
CBDC: Financial Stability or Instability?

- My model does not speak directly to this issue.

- However, I find instability claims implausible—the consolidated banking sector (central and private banks) can easily ward off Diamond and Dybvig (1983) instability.

- Moral hazard? State banking?
  - System must already deal with these issues (regulatory design problem).

- Shadow banking? A problem with or without CBDC.
Things My Model Leaves Out

- Uncertainty (bank assets, macroeconomic); bank capital; moral hazard; bank regulation; social role for bank franchise value; shadow banks, non-bank financial arrangements; international considerations, etc., etc.

- Question: how any of these factors may serve to overturn/modify conclusions reached here?

- Only one way to find out.

- Also, would be of some interest to explore potential merits of NIRP in this environment.
Summary and Conclusions

- CBDC need not entail a large intervention, is likely to increase financial inclusion, reduce bank profits, and leave bank lending operations unaffected.

- If political-economy requires banks to sign off on CBDC, carrots might include
  - Operate CBDC-like program via banking system (100% reserve backed interest-bearing segregated accounts).
  - Tax breaks, regulatory relief (where appropriate).

- These thoughts are preliminary: comments/criticisms welcome!
Contact Information

Email: david.andolfatto@stls.frb.org

Twitter: @dandolfa

Blog: http://andolfatto.blogspot.com/