

CBDC and banks: Disintermediating fast and slow

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September 28, 2024

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Slow disintermediation

A widely available CBDC would serve as a close – or, in the case of an interest-bearing CBDC, near-perfect – substitute for commercial bank money. This substitution effect could reduce the aggregate amount of deposits in the banking system, which could in turn increase bank funding expenses, and reduce credit availability or raise credit costs for households and businesses.

- The U.S. Dollar in the Age of Digital Transformation, BoG, January 2022

Fast disintermediation

The novelty with CBDCs is that they would provide access to a safe asset that - unlike cash - could potentially be held in large volumes, in the absence of safeguards, and at no cost, accelerating 'digital runs'. Such runs could even be self-fulfilling. . .

- Fabio Panetta, ECB, speech in April 2022

What we do

- **Novel survey results** from large Bundesbank household survey
 - Inclusion of 5 questions related to CBDC and prospective adoption
 - Focus on CBDC holdings in normal times and behavior in stress
- **Macroeconomic model** with CBDC, banks and possibility of runs
 - 'Slow' and 'fast' disintermediation should be analyzed *jointly*
 - Examine implications for financial stability, policy design and welfare

What we find

- **Survey** evidence \Rightarrow CBDC introduction may induce 'slow' and 'fast' disintermediation
 - \approx half of households would adopt unremunerated D€ (higher if remunerated)
 - Reallocate from bank deposits to D€ in normal times
 - Stronger propensity in times of stress
- **'Slow disintermediation'** due to shrinking (fragile) banking system
 \rightarrow **improves** financial stability
 - CBDC reduces the liquidity premium obtained by banks on their deposits
- **'Fast disintermediation'** as CBDC is suitable asset to run to
 \rightarrow **worsens** financial stability
 - Safe haven in runs that can be held - unlike cash - in large quantities
- On net, unremunerated CBDC worsens financial stability/welfare, but. . .
 - **Holding limits can reverse this and make CBDC welfare-improving**
 - **Intuition:** Keep the slow disintermediation, without the fast

Survey

Survey questions

We use the Bundesbank Online Panel (BOP-HH)

- Survey on Consumer Expectations - April 2023 (wave 40)
- \approx 6000 German respondents
- We added questions focusing on:
 - Steady state holdings of (unremunerated) CBDC
 - Interest elasticity (allowing remunerated CBDC)
 - Run propensity (systemic bank stress)
- Contains many other useful characteristics

▸ Questions

Who wants (any) D€?

Households appear 'open' to D€

- Around half 'want' D€ if unremunerated
- Remuneration raises adoption substantially (of course)
- Note: In April '23 deposit rates were low (median 22bp)

<i>Rate</i>	<i>1</i>	<i>R_d-50bp</i>	<i>R_d</i>	<i>R_d+50bp</i>
<i>% with D€ > 0</i>	43	31	54	69

CBDC adoption and heterogeneity

Who is **less** / **more** likely to adopt CBDC (on extensive margin, 5% sig.)?

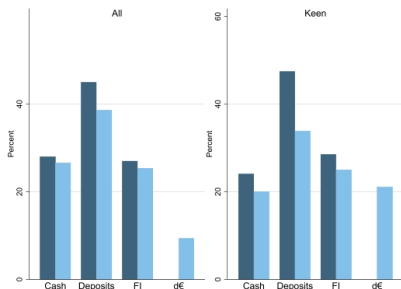
- **Low trust in ECB (-22pp)**
- **East German adult**
- **High deposit ratio**
- **Old**
- **High trust in ECB (+10pp)**
- **Low assets**

Also, random treatment with **extra info on CBDC backing** (relative to deposits) is influential in times of stress (+9pp)

Portfolio decisions of households

Turning to the intensive margin...

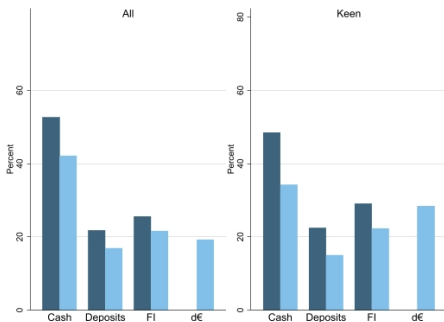
- Average D€ portfolio share is 10%
- D€ to cash ratio is around 56%
- Evidence of a symmetric elasticity of substitution around bank deposit rate
- Conditional on $D\text{€} > 0$ ('keen') the av. share surpasses that of cash



Withdrawals during banking stress

Greater openness to D€ in stress than in normal times

- 58% rate of positive withdrawals (vs 49% with $D\text{€} > 0$ in normal times)
- Cash is dominant but D€ reduces that
- Presence of D€ \Rightarrow greater deposit withdrawals overall (i.e. not just substituting for cash)



Takeaways from survey for model

1. 'Slow' disintermediation

- Substantial prospective reallocation from deposits to D€ in normal times

2. 'Fast' disintermediation

- Willingness to shift to CBDC increases during banking stress
- CBDC leads to increased withdrawals from banks under stress

Macro model with runs & CBDC

Macro model with runs

Agents in the model

- **Households:** consume, work, invest, (and run)
- **Banks:** intermediate between households and firms
- **Monetary authority:** sets policy rate, issues cash and CBDC
- **Non-financial firms:** produce output, issue securities
- **Government authority:** sets taxes, bonds in zero net supply

Households

- Access to **three liquid assets**: cash Ca_t , CBDC $D_{CB,t}$ and deposits D_t
 - Cash: unremunerated, but faces increasing convex storage costs
 - Deposits: promise return \bar{R}_t , but pay only a fraction in case of run
 - CBDC: unremunerated in most of our analysis, no storage costs
- Liquid assets are aggregated to constitute **money** M_t

$$M_t = \left[Ca_t^{\frac{\eta_m - 1}{\eta_m}} + \mu_d D_t^{\frac{\eta_m - 1}{\eta_m}} + \mu_{cb} D_{CB,t}^{\frac{\eta_m - 1}{\eta_m}} \right]^{\frac{\eta_m}{\eta_m - 1}}$$

- Money reduces marginal transaction costs $s(M_t/C_t)$
 - **Transaction services** \Rightarrow **additional payoff beyond explicit return**
- Can also invest in securities issued by non-financial firms
 - Earn stochastic return and can trade securities for price Q_t
 - **Less efficient investors than banks**

Banking sector

- Banks are more efficient than households in managing investments
 - Costly for hholds (and CB) to hold securities beyond some critical level
 - Wedge in hhold EE if required to hold larger amounts
- If the households (and CB) hold too much in aggregate, the 'effective price' they face is increased
 - Requires a discount in the actual price, Q_t to clear, if banks sell to hholds/CB at scale

Endogenous runs

State space is partitioned into two regions (determined endogenously by fundamentals)

1. Safe region: Banks can always pay back depositors \Rightarrow No runs
2. Fragile region: Banks cannot repay if run occurs \Rightarrow Runs are **possible**

In fragile region, 'recovery rate', x_t^* is < 1

$$x_t^* \equiv \frac{[(1 - \delta)Q_t^* + Z_t^*]S_{t-1}^B}{\bar{R}_{t-1}D_{t-1}} < 1.$$

Endogenous runs

- Fragile region: **Multiple 'equilibria' in spirit of Diamond and Dybvig (1983)**
 - High leverage and high asset prices \Rightarrow economy in fragile region
 - In this case a run would induce a huge price collapse
 - For a run, need to be in fragile region **and** sunspot shock active
- Collapse in security prices when banks are run \Rightarrow justifies run (REE)
 - Banks cannot cover 'promised' return on deposits
 - Households (and CB) absorb the firesold assets
 - Investment collapses via q-theory
- Run wipes out net worth of incumbent banks
 - New banks are always being born (not just in run times)
 - Do not immediately have enough net worth to take the strain
 - **Households have to absorb 'too many' securities**

Banking sector

- Banks tempted by risk-shifting incentives
 - Limited liability distorts the choice between good and bad assets
 - Incentive compatibility manifests as leverage constraints
- Volatility affects risk-shifting incentives and, thus, permitted leverage
 - Low volatility implies less temptation
 - More leverage consistent with incentive compatibility
- Time varying volatility induces **'credit boom and (maybe) bust'**
 - **Paradox of calm** (Adrian+Shin, Brunnermeier+Sannikov)
 - Leverage builds in good (low vol) times, and **spike in vol triggers (vulnerability to) run**

Monetary authority

- Issues liabilities (cash and CBDC), purchases assets
 - Remits profits to maintain constant (assumed zero) net worth
 - Uses funds from issuance to buy securities at market price Q_t
- How effective is the central banker as investor?
 - Conservative choice: As (in)efficient investor as households
 - Should caveat precise welfare calculations in absence of (difficult!) model of CB as 'fund manager'/'investor'
- Taylor Rule for setting the nominal interest rate $R_{I,t}$

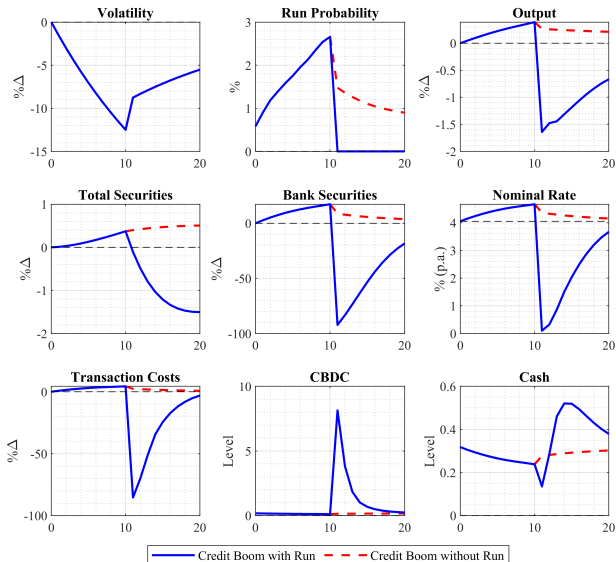
Calibration and global solution method

Calibrate the model to euro area data **and exploit the survey**

- Historical data and existing literature guide most parameters
- No historical data for CBDC!
- **Match CBDC:cash ratio from survey to pin μ_{CB}**
- Use a baseline calibration *and* a 'keen' calibration with a larger uptake
- Keen calibration uses answers from respondents with $D_{€} > 0$ in normal times

Results

Endogenous bank run and CBDC



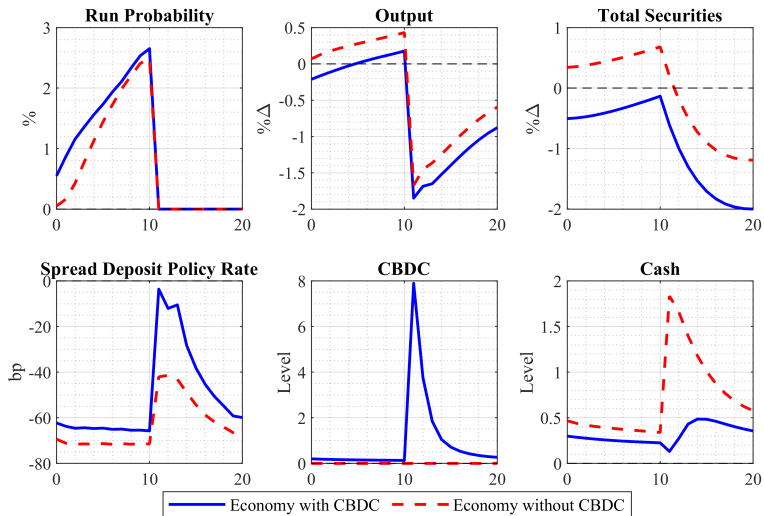
Economy with and without CBDC

CBDC plays an important role for the risk of a bank run

- Households run to CBDC instead of cash
- Reflects 'storage at scale' vs convex costs of cash holdings
- In absence of CBDC new banks can take up some of the strain of absorbing securities
- But greater disintermediation with CBDC undermines that
- Price declines more severe - increasing fragility of economy

⇒ Run probability is larger with CBDC

Economy with and without CBDC



Transmission channels

1. Liquidity premium

- CBDC reduces demand for deposits, *all else equal*
- Banks have to pay more for deposits
- Positive aspect of 'slow' disintermediation
- Smaller and less levered banks \Rightarrow Financial stability improves

2. Storage at scale

- No technological barrier that prevents scaling up CBDC holdings
- Cash has storage costs: second-order normally, but important during run
- Worsens capability of (already weak/small) new banks to replace failed banks
- Easier to run \Rightarrow Financial stability deteriorates

Financial stability and welfare implications

	Base CBDC $\mu_{cb} = 0.86$	No CBDC $\mu_{cb} = 0$	Keen CBDC $\mu_{CB} = 0.98$
Welfare W (CE)	—	0.13	0.04
Run probability	2.46	1.34	2.10

Unremunerated CBDC decreases financial stability and welfare

- 'Fast' disintermediation dominates!
- **Welfare:** How much would pay to avoid moving to baseline CBDC case (positive even with 'keen' calibration - high μ_{CB})
- **Run prob:** Dominates welfare (despite SS effect of smaller economy)
- Caveat: Recall conservative stance on CB use of funds from CBDC

Design of CBDC

Holding limits

- CBs seem likely to **complement CBDC with holding limits**
 - Ostensibly to avoid 'fast' disintermediation
 - d€ discussions → approximately €2500 - 3000
 - d£ discussions → approximately £10000 - 20000
- We add limit to household problem

$$D_{CB,t} \leq \bar{D}_{CB}$$

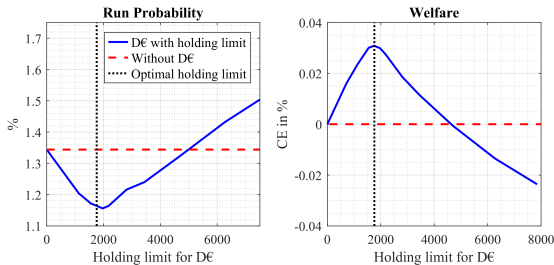
- How does this affect 'slow' and 'fast' disintermediation?
 - Affects the 'storage at scale' channel
 - But tight limit \Rightarrow trade-off as holdings in normal times could be constrained

Optimal holding limit

Unremunerated CBDC **with holding limit** is superior to a no CBDC world

- Allows benefits of 'slow' disintermediation but limits 'fast'
- Active debate exists over the level of the holding limit
- Model implies values in a range €1500 – 3000
- In line with values mooted by ECB officials

▶ Remunerated CBDC



CBDC economy, No CBDC, Baseline

Conclusion

Examined the impact of CBDC on banks and the broader economy

- Draw on novel survey evidence and a structural macroeconomic model

Survey indicates substantial demand for CBDC

- Results suggest 'slow' and 'fast' disintermediation

Macro model to capture both phenomena and to discuss policy prescriptions

- Unremunerated CBDC 'alone' decreases financial stability and welfare
- But, limits (or remuneration pegged to policy rates) can reverse that result

Watch this space: We just ran a survey to calibrate CBDC adoption in a het agent (hhold and bank) economy

Appendices

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Survey introduction

Introduction (translated)

The introduction of the D€ is currently being investigated by the European Central Bank (ECB) and the national central banks of the euro area, such as the Bundesbank.

The D€ would be digital money that would be used like money on a current account. However, it would be issued and guaranteed by the ECB and the national central banks.

The D€ would exchangeable for euro in the form of cash at any time and also be used for payments at all times. By contrast, the availability of money on a current account with a private commercial bank depends to some extent on the stability of that commercial bank.

The D€ would not replace cash or accounts with commercial banks, but would be an additional offering alongside these. The D€ would enable everyday payments to be made digitally, quickly, easily, securely and free of charge throughout the euro area.

where the **red** section is included for a *random* subset of households as treatment

Steady state holdings

Steady state holdings (without CBDC)

*Now imagine you had €1,000 available each month to allocate across different asset classes. In this context, please assume that **the D€ does not yet exist.***

How much of the €1,000 per month would you hold as cash, deposit into your current account, or invest in other financial instruments?

Steady state holdings (with CBDC)

*Please now assume that the D€ were to be introduced. Please also assume that you have a D€ account that you can use to hold D€. **You would receive no interest on this D€ account.***

How much of the €1,000 per month would you now deposit into your D€ account, hold as cash, deposit into your regular current account at your bank, or invest in other financial instruments?

where they are reminded of their first answer when asked the second question (and they are forced to account for all €1000)

Interest elasticity

Interest elasticity

You stated that, if you received no interest on your D€ account, you would allocate the money as follows:

*< **they are reminded of their previous answer** >*

Please now assume that you would receive an interest on your D€ account that would be (25bp higher/equal/25bp/50bp lower) the interest rate on your regular current account at your bank.

How much of the €1,000 per month would you now deposit into your D€ account, hold as cash, deposit into your regular current account at your bank, or invest in other financial instruments?

Run propensity - I

Run behavior (without CBDC)

*The next section is about **money that you already have on your regular current account** at your bank. Imagine that you had €5,000 on your current account.*

*In addition, please assume that according to credible news sources there are **doubts about the stability of the banking sector**. This could **lead to** a banking crisis that could also affect your bank. If this were to happen, **you might have problems accessing your current account at short notice to withdraw money or make credit transfers**.*

*In this situation, how much of the €5,000 would you **withdraw** as cash from your regular current account or invest in other financial instruments?*

Run propensity - II

Run behavior (with CBDC)

*Now please imagine that a D€ was available as an alternative to cash and other financial assets. Please also imagine that you would receive **no interest** on the D€.*

Please remember that the D€ would be able to be exchanged for euro in the form of cash at any time and also be used for payments at all times.

In this situation, how much of the €5,000 would you transfer from your regular current account to your D€ account or invest in other financial instruments?

where they are reminded of their first 'run' answer when asked the second 'run' question and the red second paragraph is only included for a random subset of households (and they are forced to account for all €5000)

▶ Back

Remuneration - Rate policy

A second design question is whether or not to remunerate CBDC holdings

- This feature used to be promoted - less so in recent times

Rate on CBDC tracks the standard policy rate, less a fixed spread Δ_{CB}

$$R_{CB,t} = R_{I,t} - \Delta_{CB}$$

Δ_{CB} is set so $R_{CB,t} \approx 0$ in steady state

Remuneration - Implications for disintermediation

Policy exploits 'slow' disintermediation and limits 'fast' disintermediation

- **During a boom**, remuneration of CBDC increases
 - CBDC becomes more attractive
 - Slow disintermediation counteracts boom
- **During a run**, remuneration would be negative
 - Policy rate drops (Taylor) brings remuneration down with it
 - CBDC becomes less attractive
 - Issues with negative CBDC remuneration?

▶ Back