Should Central Banks Issue Digital Currency?

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Introduction

- Define a central bank digital currency (CBDC) as:
  - an electronic liability of the central bank (outside money)
  - exchangeable on demand for existing forms of currency
  - can we held by a wide range of actors (perhaps even individuals)
- Not about crypto or blockchain *per se*
    - these technologies may make introducing a CBDC easier, but ...
- Could simply be allowing accounts at the central bank
  - either directly or indirectly
    - through existing banks, or the post office, or a narrow bank ...
- Raises a number of interesting (and difficult) questions

Our motivation

- Interest sparked in part by Bordo and Levin (2017)
  - they argue strongly in favor of a CBDC
  - and a particular design: interest bearing accounts at the CB
- Part of their argument is clear
  - interest bearing $\rightarrow$ provides a good medium of exchange
  - in a sense, the same logic as the Friedman rule
- This argument has parallels in the corridor-vs-floor debate
  - floor system: remove banks' opportunity cost of holding reserves
  - CBDC: remove non-banks' opportunity cost of holding CB money
  - seems like someone who favors a floor should also favor CBDC

However ...

- ... what if a CBDC disintermediates banks?
  - if many bank depositors switch to a CBDC ...
  - how will that affect bank lending? aggregate investment?
  - from a macroeconomic perspective, seems very dangerous
- Our objective in this paper: reconcile these two views
- Originally, we thought of CBDC as a far-off possibility
- Recent events indicate it may not be so far off
  - if the CB operates a floor system ...
  - and someone is able to set up a narrow bank ...
  - economic effect ≈ allowing non-banks to deposit with the CB
- We need (urgently) to think about the effects of CBDC

- There is a growing literature on the topic
  - expository: Bech and Garratt (2017)
  - discussions: BIS (2018), Berentsen (2018), Bordo and Leven (2017), Engert and Fung (2017), Fung and Halaburda (2016), Kahn, Rivandeneyra and Wong (2017), Ketterer and Andrade (2016), and others
  - policy speeches: Broadbent (2016), Mersch (2017), others
  - models: Barrdear and Kumhof (2016), Davoodalhosseini (2018)
  - plus blog posts, etc.
- However, the basic macroeconomic impacts are still not well understood
  - represents a potentially radical change in the monetary system
  - research is still in the early phases

Our findings

- An interesting policy tradeoff arises in our model
  - an attractive CBDC can help overcome trading frictions ...
    - i.e, the Friedman rule logic applies
  - ... but may worsen investment frictions
    - by increasing bank funding costs, decreasing deposits (disintermediation)
- CB can choose the interest rate to balance these two concerns
  - this rate is a new (and useful) policy tool
  - result: introducing a CBDC increases welfare (at least weakly)
- Model provides guidance on how the interest rate should be set
  - example: a CBDC should earn the market interest rate

Outline

1. The setup
2. Equilibrium with no digital currency (current)
3. Introducing digital currency (future)
4. Conclusions

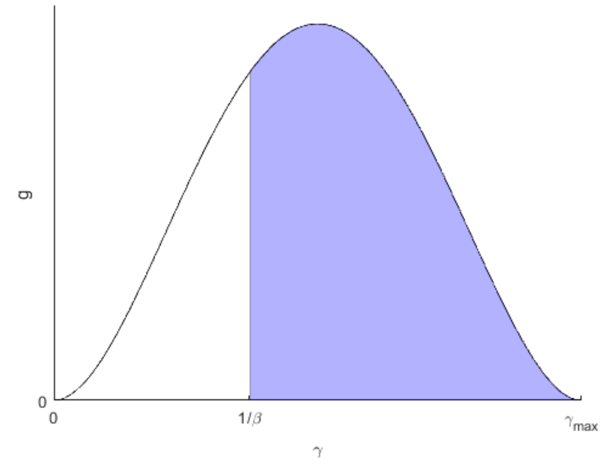
1. The Setup

Time and agents

- Builds on the structure in Lagos & Wright (2005)
  - $t = 0,1,2, \ldots$
- Two sub-periods in each period
  - a centralized market (CM) – investment
  - then a decentralized market (DM) – medium of exchange
- Five types of agents
  - buyers and sellers trade in the DM
  - entrepreneurs invest (and produce) in the CM
  - banks intermediate
  - central bank can issue digital currency

Entreprenuers

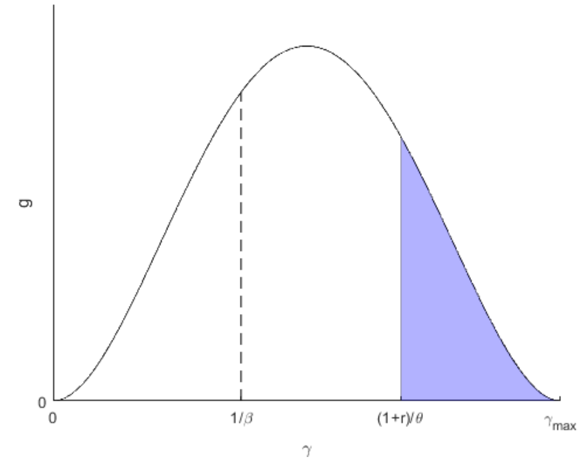
- Live for two periods (new generation born each period)
- Only participate in the centralized market
- Have access to an indivisible production technology
  - requires input of 1 unit in CM when young
  - generates output γ_j in CM when old (heterogeneous)
  - $\gamma_j \sim [0, \overline{\gamma}]$ with cumulative distribution G and density function g
- Consume only when old
  - risk neutral
- No endowment ⇒ must borrow



Banks

- Entrepreneurs can borrow in CM from *banks*
  - loan market is competitive; real interest rate = $1 + r_t$
- Imperfect pledgeability:
  - entrepreneur can abscond with a fraction $(1 - \theta)$ of their output; need:

$$1 + r_t \leq \theta \gamma_j$$



  - some productive projects may remain unfunded
  - as in Kiyotaki & Moore (1997), others
- Banks raise funds by issuing deposits in CM to buyers
  - deposit = claim on CM consumption in period $t + 1$
  - competition ⇒ interest rate on deposits = interest rate on loans

Buyers and sellers

- Buyers: like to consume the DM good $U^b = x_t^b + u(q_t)$
- Sellers: can produce the DM good $U^s = x_t^s - w(q_t)$
  - randomly matched in the DM
  - purchases must be made with money or deposits
  - discount rate: $\beta < 1$
- Two situations
  - <u>current</u>: buyer must pay with bank deposits
  - <u>future</u>: pay with deposits or with digital currency

    $\Rightarrow$ potential exists for CBDC to crowd out bank deposits
    - recall: deposits fund loans to entrepreneurs
- Paper includes physical currency, different types of sellers

Central bank

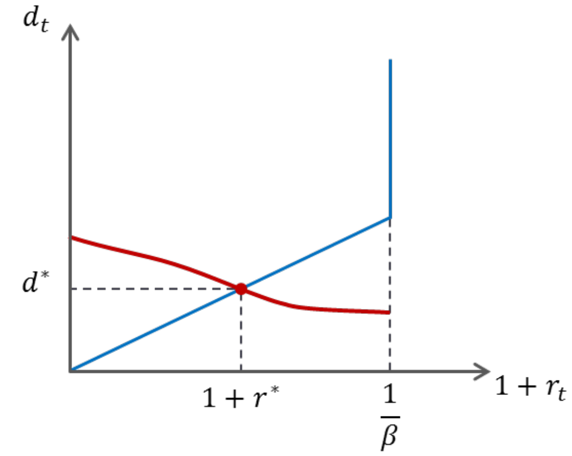
- Implements an inflation target: $\frac{p_{t+1}}{p_t} = \mu$ for all t (given)
  - stands ready to buy/sell CM goods at the desired price
  - financed as needed by lump-sum taxes/transfers

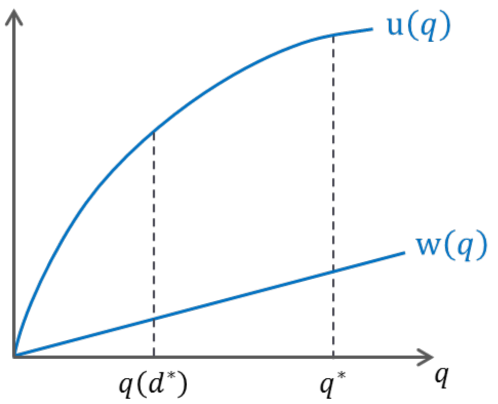
    ⇒ represents the consolidated public sector
- Chooses nominal interest rate $1 + i^e$ on digital currency
  - real interest rate $= \frac{1+i^e}{\mu}$
- Objective: maximize equal-weighted sum of all utilities

2. Equilibrium with no digital currency (current)

Demand for deposits

- Buyer chooses d_t based on rate of return
  - well-defined function for return $< \frac{1}{\beta}$
  - vertical when return $= \frac{1}{\beta}$
- Supply of deposits from banks will determine $1 + r$
  - and equilibrium real balances d^*
- Real deposits determine the amount of DM production, trade



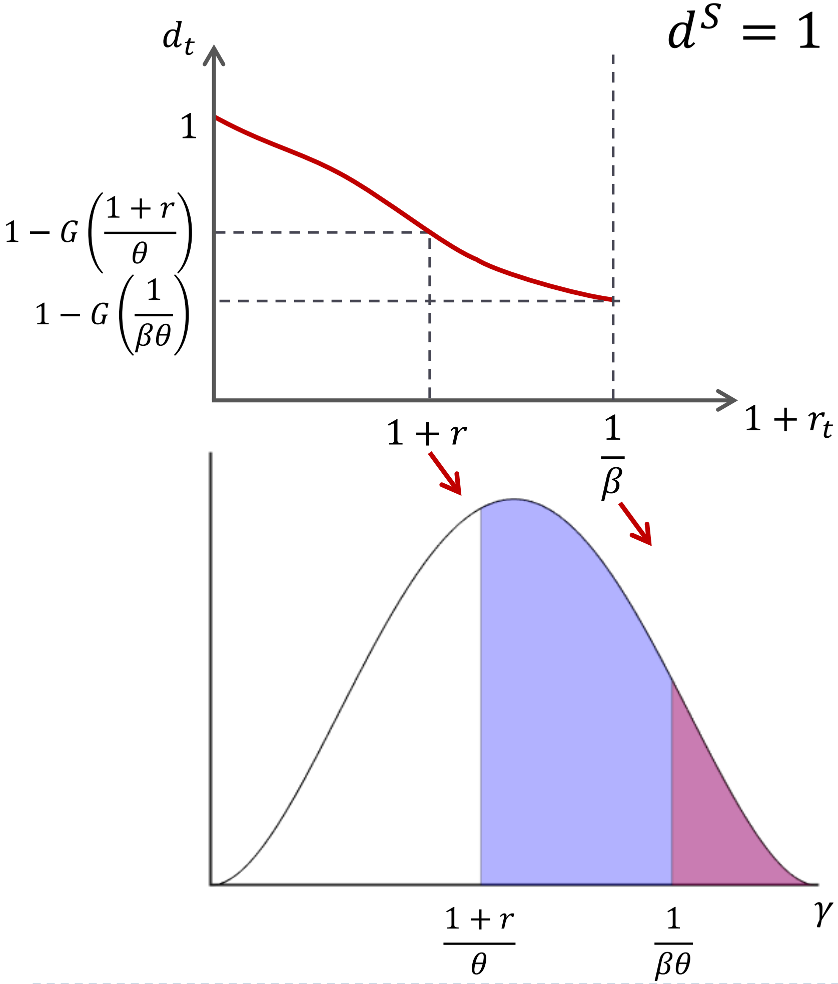


Q: What determines the supply of deposits?

Supply of deposits

- Supply of deposits depends on the distribution of projects

$$d^S = 1 - G\left(\frac{1 + r_t}{\theta}\right)$$



- When $1 + r_t = 0 \Rightarrow$ all projects are funded
  - supply of deposits is $d^s = 1$
- As r_t increases, fewer projects are viable
  - bankers issue fewer deposits

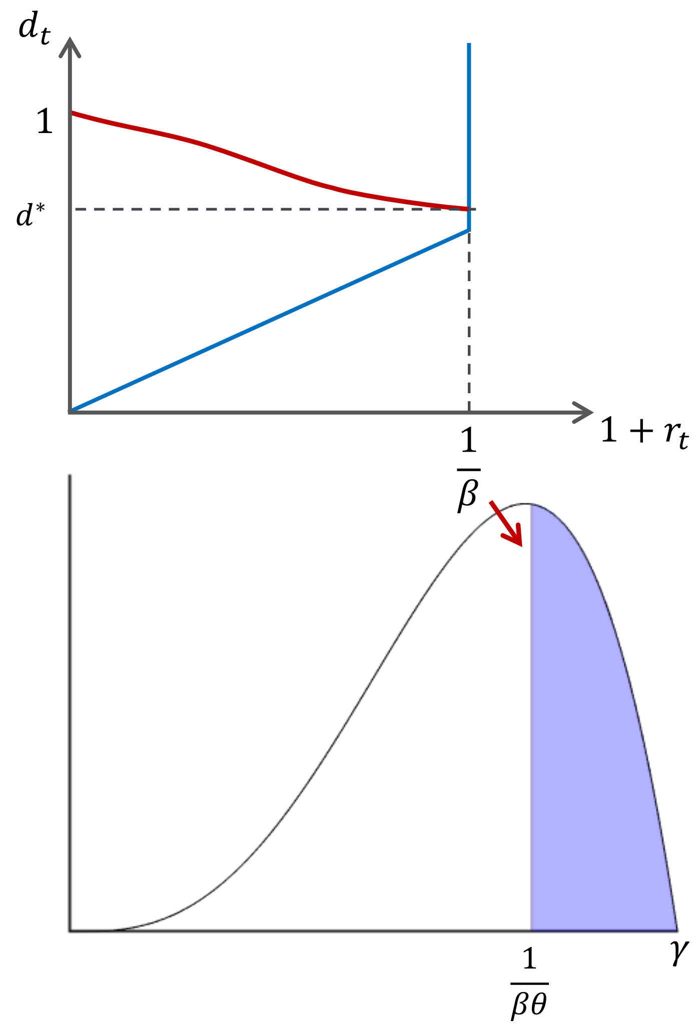
$\Rightarrow$ supply curve slopes downward

Equilibrium: two cases

A) High-return projects are plentiful

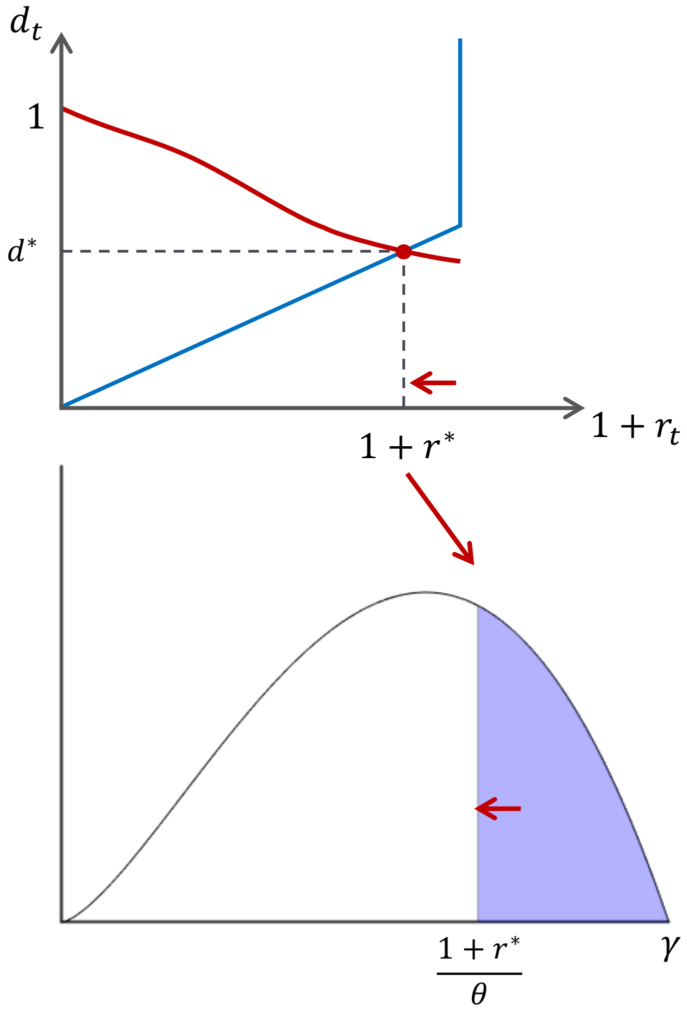
- Results:
  - $1 + r = \frac{1}{\beta}$ (same as illiquid bond)
  - $q = q^*$ in deposit meetings (good)
  - $\hat{\gamma} = \frac{1}{\theta\beta} > \frac{1}{\beta}$ (inefficiently high)

Note: if $\theta = 1 \Rightarrow$ allocation is efficient



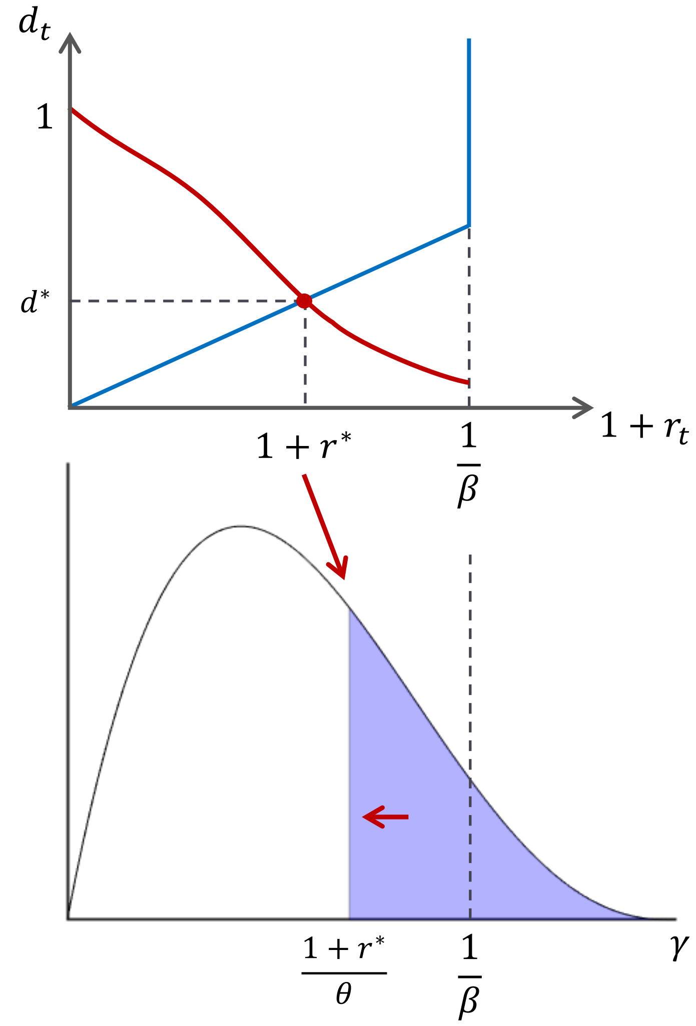
B) High-return projects are scarce

- Results:
  - $1 + r < \frac{1}{\beta}$ (liquidity premium)
  - $q < q^*$ in deposit meetings (bad)
  - $\hat{\gamma} < \frac{1}{\theta\beta}$ (can be good)



B) High-return projects are scarce

- Results:
  - $1 + r < \frac{1}{\beta}$ (liquidity premium)
  - $q < q^*$ in deposit meetings (bad)
  - $\hat{\gamma} < \frac{1}{\theta\beta}$ (can be good)
- Note:
  - can have $\hat{\gamma} < \frac{1}{\beta}$ (too low)
  - more likely to occur when θ is high



3. Introducing digital currency (future)

Effects of introducing a CBDC

- Assume CBDC is perfect substitute for deposits in exchange
- Result: places a lower bound on the deposit interest rate
  - banks must pay at least $1 + i^e$ to attract any deposits
  - may or may not bind, depending on $(1 + i^e)$ vs. $\mu(1 + r)$
- Questions:
  - what happens to CM investment $(\hat{\gamma})$, DM trade (q), and welfare?
  - how should the central bank set $1 + i^e$?
- Need to examine the two cases ...

A) When high-return projects are plentiful

- CBDC has no effect in our baseline model
- More generally: may replace physical currency in some transactions
  - if so, raises welfare
  - does not crowd out deposits or change CM investment

Optimal policy:

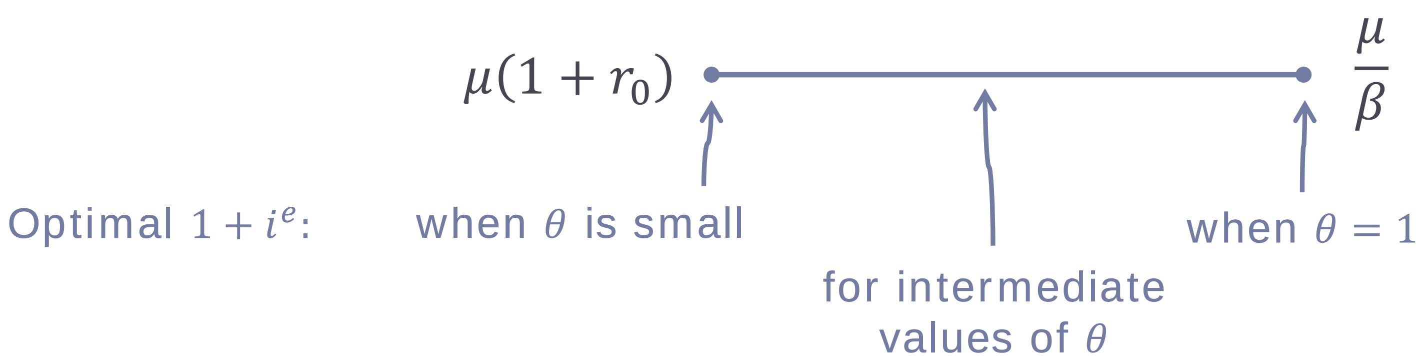
- Central bank should set $1 + i^e = \frac{\mu}{\beta}$
  - all DM production and exchange is efficient
  - matches recommendation of Bordo and Levin (2017), others?
- CM investment is inefficiently low because of the friction
  - but monetary policy cannot help solve this problem

B) When high-return projects are scarce

- If $1 + i^e \leq \mu(1 + r_0) \Rightarrow$ no crowding out $\Rightarrow$ same as before
- If $1 + i^e > \mu(1 + r_0)$:
  - CBDC begins to crowd out deposits $\Rightarrow$ tradeoff arises
    - raises q^* in all DM meetings (good)
    - increases investment cutoff $\hat{\gamma}$ (may be bad)

Optimal policy :

- Central bank should set $\mu(1 + r_0) \leq 1 + i^e \leq \frac{\mu}{\beta}$



4. Conclusions

Summarizing the results

1) If there are no frictions in credit markets ($\theta = 1$):
   - introducing a CBDC always raises welfare
   - CB should set the (real) interest rate on the currency high ($= 1/\beta$)
   - this may raise bank funding costs and create disintermediation …
   - but that is good: investments that lose funding were inefficient

2) If you want to argue against CBDC, credit market frictions must be present ($\theta < 1$)
   - even then, introducing a CBDC always has some benefits
   - but it may exacerbate the effects of the credit market frictions

   ⇒ a policy tradeoff arises

3) CB can use the interest rate on CBDC to manage this tradeoff

- in our model, introducing a CBDC never decreases welfare, and often increases it
- even if some (undesirable) disintermediation occurs

4) Model offers guidance on how this interest rate should be set

- CBDC should earn at least the same rate as bank deposits
- but this statement alone does not fully characterize optimal policy
- key issue: should the CB aim to <u>change</u> the real interest rate when introducing a CBDC?
  - if $\theta \ll 1$ and/or current liquidity premium is small $\Rightarrow$ no
  - but if $\theta \approx 1$ and/or current liquidity premium is large $\Rightarrow$ yes

Summing up

- An "indirect" form of CBDC may be closer than we realize

  ⇒ increased urgency to think about the impacts of a CBDC

- A CBDC does pose potential problems ...
  - could disintermediate banks, raise the cost of funding for firms
- Our model suggests:
  - these problems can be managed by controlling the interest rate on the CBDC
  - may require the CB to pay different IOER rates to narrow and "regular" banks?
- But ... more research is needed
  - example: what would happen is a crisis?