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
- The logic is clear, compelling
  - interest bearing → provides a good medium of exchange
  - in a sense, the same logic as the Friedman rule
- Their arguments have parallels to the corridor-vs-floor system 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 system 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 (which the Fed currently does)
  - 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, Rivadeneyra 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 approach

We study the effect of introducing a CBDC in a setting where:

- Both central bank money and deposits are used in exchange
  - as in Lagos and Wright (2005), many others
  - quantity and “quality” of available media of exchange matter
  - the potential exists for a CBDC to crowd out bank deposits
- Banks use deposits to finance productive investment
  - a decline in deposits can affect credit conditions, investment
- Financial frictions potentially limit investment
  - borrowing constraint as in Kiyotaki and Moore (1997) and others
  - allow for possibility that the level of investment is inefficient

Results

- An interesting policy tradeoff arises in our model
  - an attractive CBDC can help overcome the trading frictions …
    - i.e, the Friedman rule logic applies
  - … but may worsen the investment friction
    - 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 environment
2. Equilibrium with no digital currency (baseline)
3. Introducing digital currency
4. Conclusions

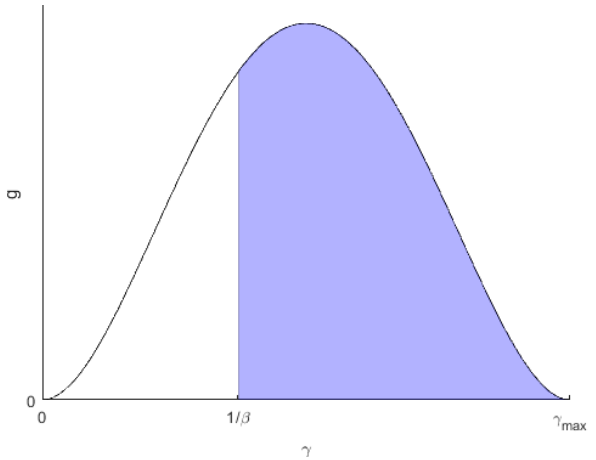
1. The Environment

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)
  - then a decentralized market with bilateral trade (DM)
- Four types of agents
  - buyers and sellers — trade in the DM
  - entrepreneurs — invest (and produce) in the CM
  - banks — intermediate
- Plus a central bank that issues currency (physical and digital)

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
- No endowment ⇒ must borrow
- Consume only when old
  - risk neutral

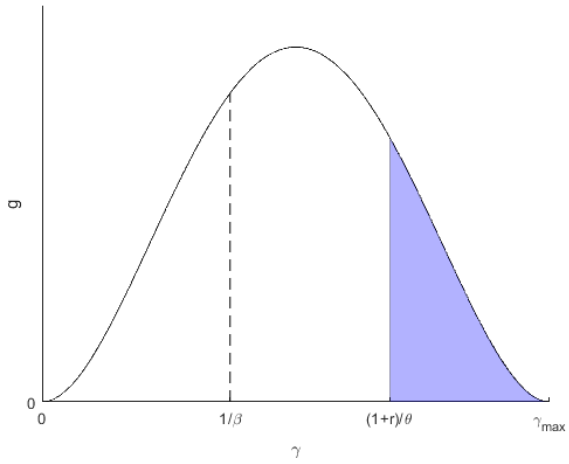


Banks

- 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

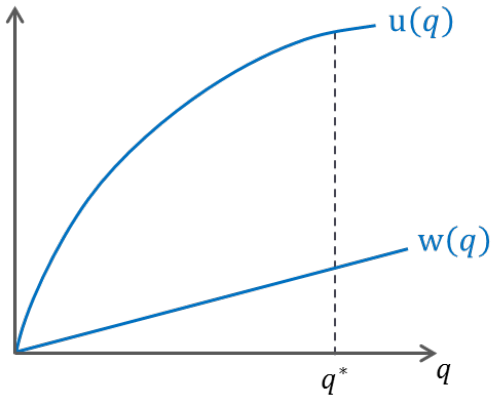


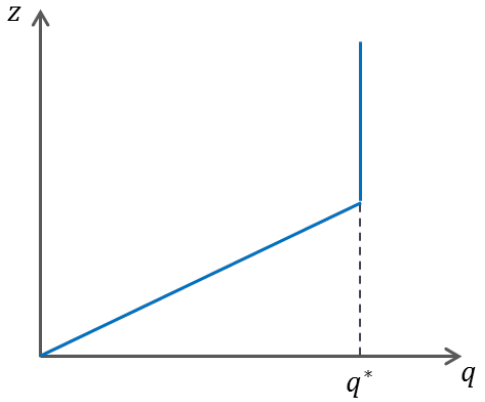
- Banks raise funds by issuing deposits in CM to buyers
  - deposit = claim on CM consumption in period $t + 1$
  - competition ⇒ interest rate on deposits = interest rate on loans

Buyers and sellers

- Buyers: like to consume the DM good $U^b = x_t^b + u(q_t)$
- Sellers: can produce the DM good $U^s = x_t^s - w(q_t)$
  - each is randomly matched in the DM with prob. α
  - discount rate: $\beta < 1$
- No bilateral credit in DM trades (due to anonymity)
  - purchases must be made with a medium of exchange
- Two types of sellers
  - type 1: only can accept currency
    - transactions where anonymity, low costs are important
  - type 2: only can accept bank deposits
    - large-value or long-distance transactions, for example

- Buyer learns type of meeting in advance
  - exits the CM holding either cash or deposits
- When matched, buyer and seller bargain over quantity, price
  - assume buyer has all bargaining power (for simplicity)
- Outcome depends on buyer's liquid assets (z)
  - "liquid" = accepted by this seller
  - if small, buyer is liquidity constrained
  - if large, buyer consumes efficient quantity q^*





Central bank

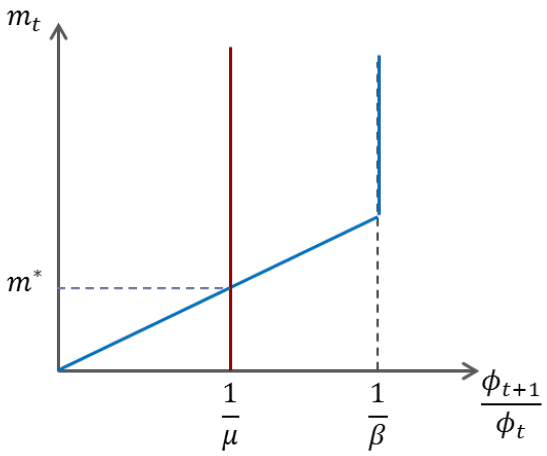
- The central bank supplies both physical and digital currency
- Implements an inflation target: $\frac{p_{t+1}}{p_t} = \mu$ for all t (given)
  - stands ready to buy/sell CM goods at the desired price
  - and to exchange physical for digital currency one-for-one
  - financed as needed by lump-sum taxes/transfers

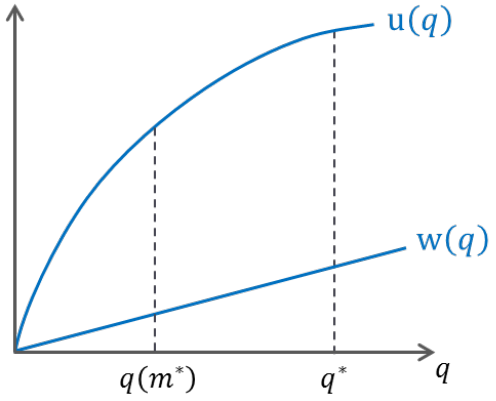
    ⇒ represents the consolidated public sector
- Digital currency earns nominal interest rate $1 + i^e$
  - real interest rate $= \frac{1+i^e}{\mu}$
- Objective: maximize equal-weighted sum of all utilities

2. Equilibrium with no digital currency (baseline)

Cash buyers

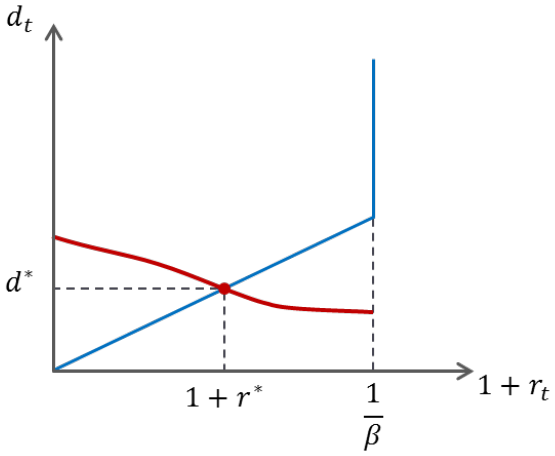
- Buyer entering a cash meeting chooses m_t based on rate of return
  - well-defined function for return $< \frac{1}{\beta}$
  - vertical when return $= \frac{1}{\beta}$
- Monetary policy determines this return (inverse of the inflation rate)
  - hence determines equilibrium real balances m^*
- Real balances determine the amount of DM production, trade
  - if $\mu > \beta$, then $q(m^*) < q^*$

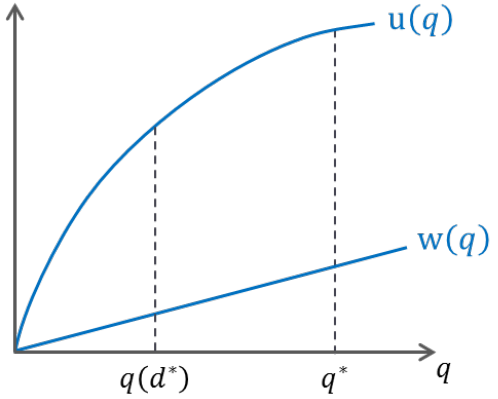




Deposit buyers

- Buyer entering a deposit meeting 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



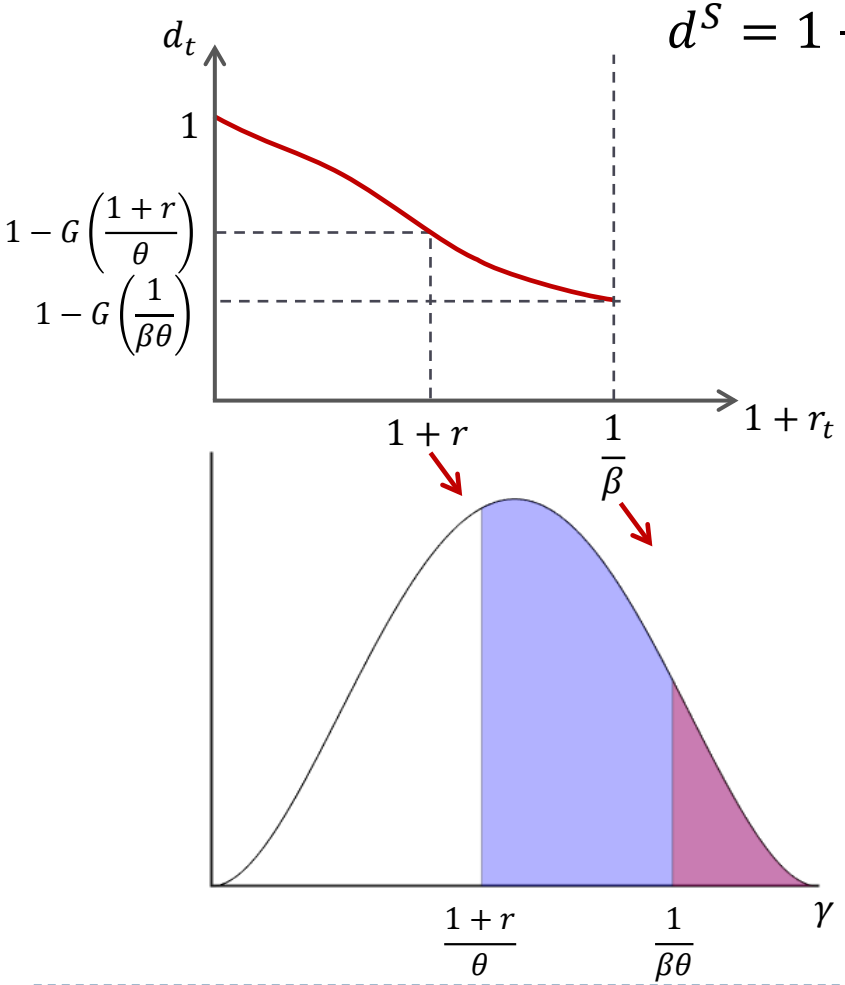


Q: What determines the supply of deposits?

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

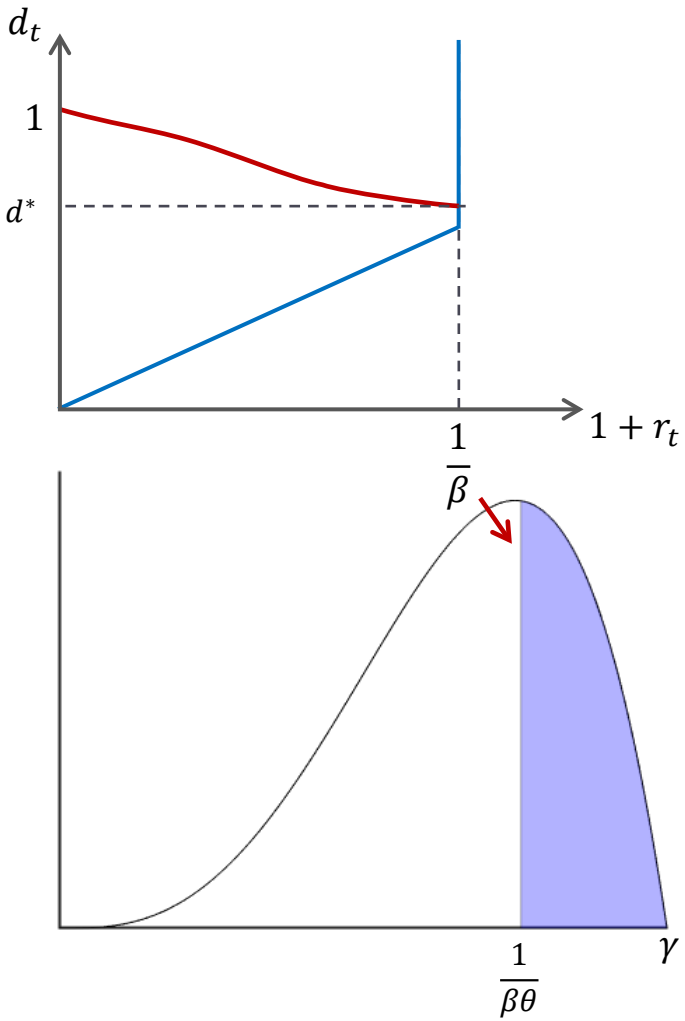
$\Rightarrow$ supply curve slopes downward

Equilibrium: three cases

A) High-return projects are plentiful

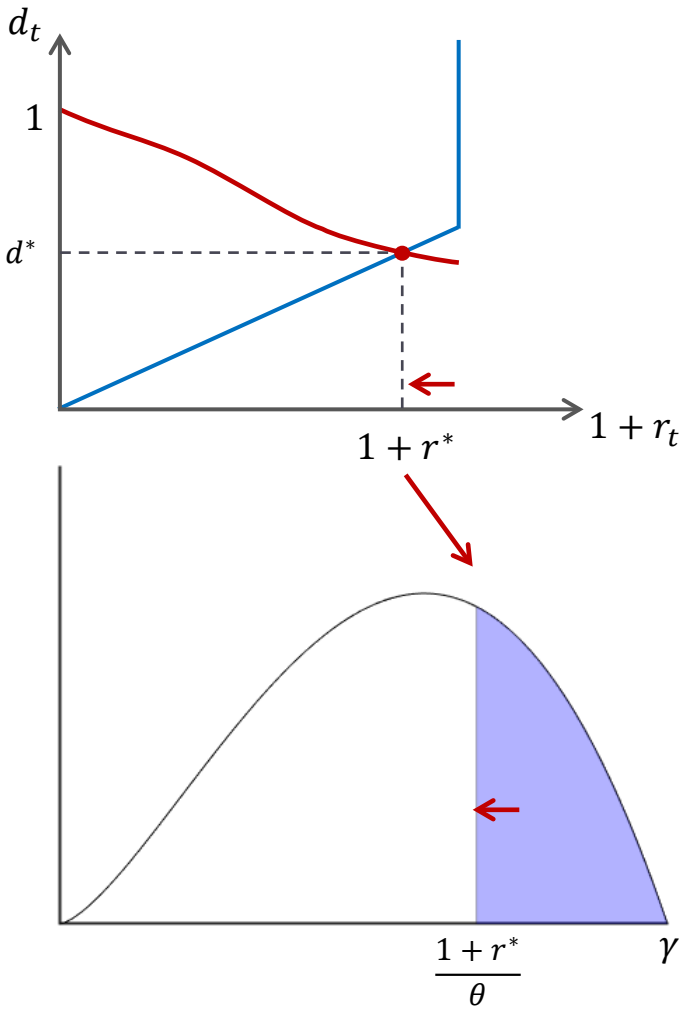
- Results:
  - $1 + r_0 = \frac{1}{\beta}$ (same as illiquid bond)
  - $q = q^*$ in deposit meetings (good)
  - $\hat{\gamma} = \frac{1}{\theta\beta} > \frac{1}{\beta}$ (inefficiently high)

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



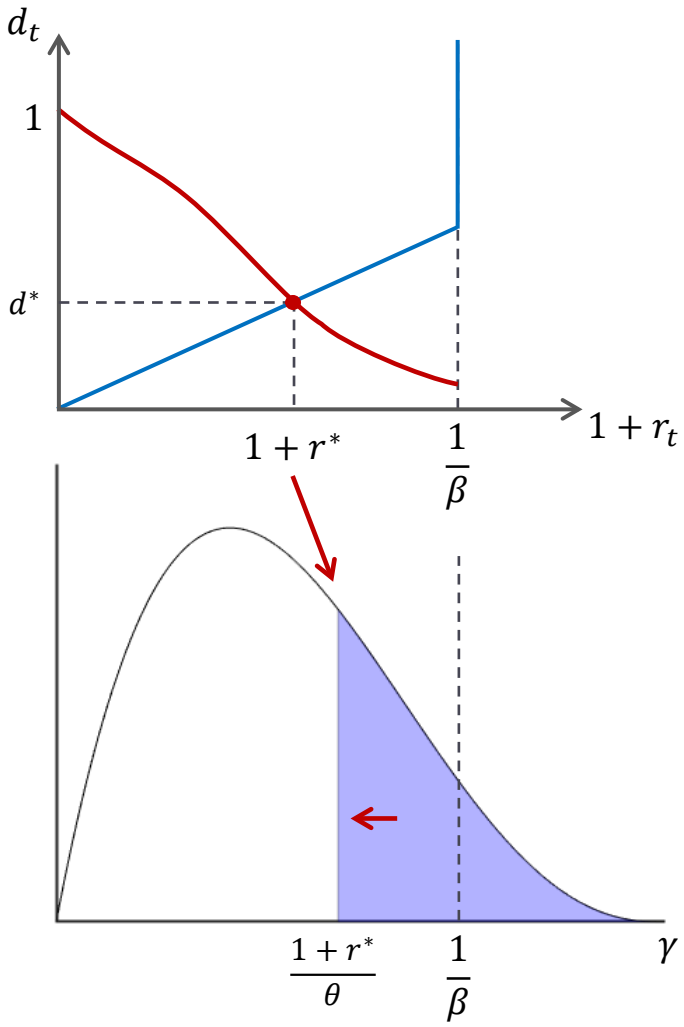
B) High-return projects are (somewhat) scarce

- Results:
  - $\frac{\theta}{\beta} < 1 + r_0 < \frac{1}{\beta}$ (liquidity premium)
  - $q < q^*$ in deposit meetings (worse)
  - $\frac{1}{\beta} < \hat{\gamma} < \frac{1}{\theta\beta}$ (better)



C) High-return projects are very scarce

- Results:
  - $1 + r_0 < \frac{\theta}{\beta}$ (↑ liquidity premium)
  - $q \ll q^*$ in deposit meetings (worse)
  - $\hat{\gamma} < \frac{1}{\beta}$ (too low!)



3. Introducing digital currency

What is a CBDC?

- CBDC is a form of outside money that can potentially:
  - earn interest at rate $1 + i^e$ (with i^e positive or negative)
  - be used in a different set of meetings as physical currency
- In the paper, we study three different possible "designs" where the CBDC can be used in:
  - cash meetings only (anonymity, low fees)
  - deposit meetings only (accounts at the central bank?)
  - all meetings (a better technology) ⟵ today: focus on this case
- Ask:
  - how introducing a CBDC affects allocations, welfare
  - how the central bank should set the interest rate $1 + i^e$

Effects of introducing a CBDC

- In cash meetings, CBDC replaces physical cash if $i^e > 0$
  - increases real money balances and quantity of DM trade
- In deposit meetings, CBDC places a lower bound on the 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. $\mu(1 + r_0)$
- Questions:
  - what happens to CM investment $(\hat{y})$, DM trade (q), and welfare?
  - how should the central bank set $1 + i^e$?
- Need to examine the three cases …

A) When high-return projects are plentiful

- For any $1 < 1 + i^e \leq \mu/\beta$:
  - CBDC replaces physical currency
  - does not crowd out deposits or change CM investment
  - always raises welfare

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 (somewhat) scarce

- If $1 + i^e \leq \mu(1 + r_0) \Rightarrow$ same as before
- If $1 + i^e > \mu(1 + r_0)$:
  - CBDC begins to crowd out deposits
  - raises q^* in all DM meetings (good)
  - increases $\hat{\gamma}$ (lower investment $\rightarrow$ bad)

Optimal policy :

- Central bank should at least set $1 + i^e \geq \mu(1 + r_0)$
  - below this point, increasing i^e improves cash meetings, with no effect on bank deposits
- For $1 + i^e > \mu(1 + r_0)$, a tradeoff arises
  - optimal choice of $1 + i^e$ balances two competing concerns

C) When high-return projects (very) scarce

- For any $\mu(1+r_0) < 1+i^e < \frac{\mu\theta}{\beta}$
  - CBDC crowds out bank deposits
    - which is <u>good</u> in this case ⇒ clearly raises welfare
- For $1+i^e > \frac{\mu\theta}{\beta}$, the tradeoff arises

Optimal policy:

- Optimal interest rate will satisfy $\frac{1+i^e}{\mu} > 1+r_0$
  - will raise the equilibrium interest rate on deposits
  - and decrease equilibrium bank deposits, CM investment
  - again balances the two competing concerns

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 change the real interest rate when introducing a CBDC?
  - if $\theta \ll 1$ and/or current liquidity premium is small ⇒ no
  - but if $\theta \approx 1$ and/or current liquidity premium is large ⇒ yes

Summing up

- An “indirect” form of CBDC may be closer at hand 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?