Should Central Banks Issue Digital Currency?

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CBDC

▸ Many central banks are considering issuing *digital currency*

  ▸ BIS (2021): 86% of central banks are studying the possibility

▸ Variety of motivations:

  ▸ improve the efficiency of payments system

  ▸ promote financial inclusion

  ▸ improve monetary policy effectiveness

  ▸ preempt growth of private digital currencies   etc.

▸ ECB: Report on a digital euro (October 2020)

  "to ensure that consumers continue to have unfettered access to central bank money in a way that meets their needs in the digital age"

▸ But also raises some concerns …

One (major) concern

▸ **If many bank depositors shift to holding a CBDC instead…**

  ▸ how will that affect banks' funding costs? bank lending?

▸ **This issue is commonly raised in policy discussions:**

  "[A] flow of retail deposits into a CBDC could lead to a loss of low-cost and stable funding for banks."

  BIS (2018)

  "A consequence could be higher interest rates on bank loans."

  Mersch (ECB, 2017)

  "[D]o the benefits … get outweighed by the negative consequences of the central bank disintermediating a large part of bank business models?"

  Meaning et al. (BoE, 2018)

▸ *Economist:* "The disintermediation dilemma" (12/5/20)

▸ One possible response: make CBDC as cash-like as possible

  ▸ for example: limit the balances an individual can hold

  ▸ require parties to be physically present to transfer balances, etc.

▸ But doing so would also limit the benefits of CBDC

▸ In addition: while disintermediating banks sounds bad …

▸ CBDC would offer individuals a *better* medium of exchange

  ▸ could be used in more transactions, potentially bear interest

▸ Why isn't that a good thing?

  ▸ seems like a step toward Friedman's optimum quantity of money

⇒ The answer is not so obvious (→ need a model)

What we do

▸ Construct a model in which:

    ▸ bank deposits are used as a medium of exchange

    ▸ and therefore give banks a "low-cost source of funding"

    ▸ banks use this funding to invest in productive projects

▸ Introduce a CBDC into this environment

    ▸ an alternative medium of exchange to cash and/or bank deposits

    ▸ pays interest at a rate chosen by the central bank

▸ Derive conditions under which a CBDC raises welfare

    ▸ focus on: tradeoffs faced by policy makers in choosing interest rate

    ▸ show: optimal policy may cause some disintermediation

    ▸ emphasize: the interest rate on CBDC is a useful new policy tool

Literature

▸ There is a growing literature on the topic of CBDC

▸ Exposition and policy discussions:

  ▸ Bech and Garratt (2017), BIS (2018), Berentsen (2018), Bindseil (2020), Bordo and Leven (2017), Kahn, Rivadeneyra and Wong (2018), Ketterer and Andrade (2016), among others

▸ Models:

  ▸ Barrdear and Kumhof (2016), Brunnerneier and Niepelt (2019), Davoodalhosseini (2018), Andolfatto (2020), Chiu et al. (2020), Fernández-Villaverde et al (2020), Schillling et al. (2020), Williamson (2020), among others

▸ Literature review: Carapella and Flemming (2020)

▸ However, the basic macroeconomic impacts are still not well understood

Outline

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2. Model

Setup

▸ **Dynamic GE model in tradition of Lagos & Wright (2005)**

    ▸ alternating centralized and decentralized markets (CM & DM)

    ▸ matching/information frictions ⇒ need for a medium of exchange

    ▸ builds on Lagos and Rocheteau (2008), Williamson (2012), others

▸ **4 types of agents:**

    ▸ buyers   produce in CM; consume in DM

    ▸ sellers   produce in DM; consume in CM

    ▸ banker/firms   borrow, invest and produce CM good

    ▸ central bank   issues currency   (consolidated public sector)

▸ **Let's look at each type of agent in turn …**

Banker/firms

▸ Bankers each have access to a productive project

  ▸ requires fixed input → normalize to 1

  ▸ generates output γ_j in the next period (heterogeneous)

  ▸ $\gamma_j \sim [0, \bar{\gamma}]$ with cumulative distribution G and density function g
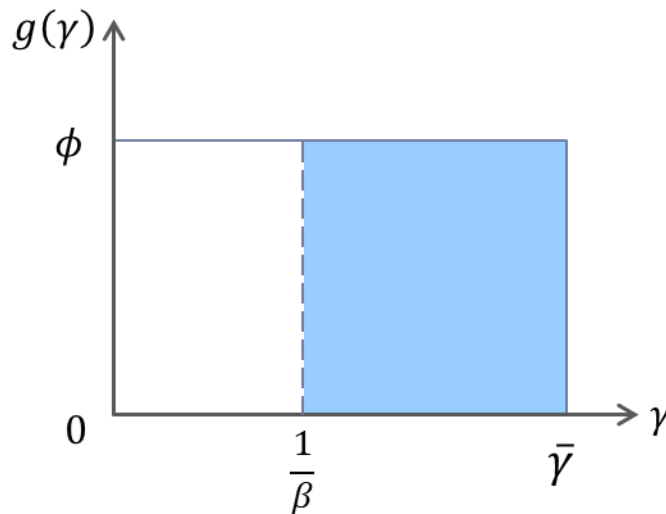
⇒ diminishing returns to (aggregate) investment

Efficiency: fund (only) those projects with $\gamma_j > \frac{1}{\beta}$

▸ Bankers live for two periods, must borrow to fund projects

  ▸ issue deposits at interest rate: $1 + r_D$ ⇒ profit $= \gamma_j - (1 + r_D)$

Financial friction

▸ Banker can only credibly pledge a fraction θ of its output

  ▸ as in Kiyotaki & Moore (1997), others

▸ Banker j is funded if

$$\boxed{1 + r_D \leq \theta \gamma_j}$$

  ▸ $\theta < 1 \Rightarrow$ some profitable projects are not funded
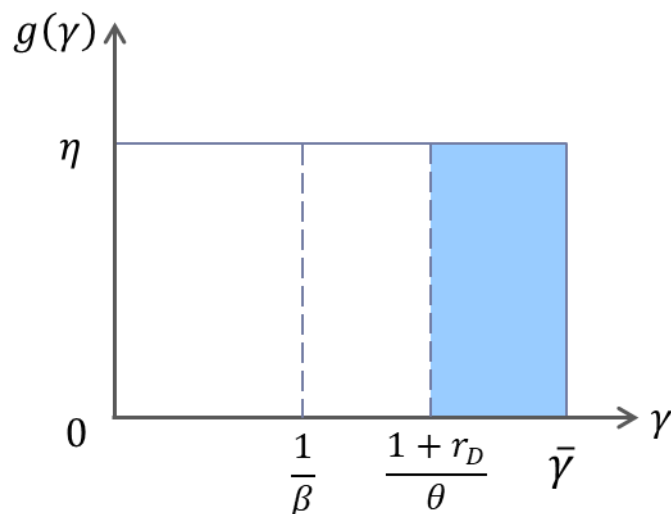
▸ $\frac{1+r_D}{\theta} > \frac{1}{\beta} \Rightarrow$ cutoff is inefficiently high

  ▸ some *socially-productive* projects are not funded

  ▸ would not arise if bankers had unlimited access to internal funds (Williamson, 2020).

Buyers and sellers

‣ Buyers: like to consume the DM good $\quad U^b = x_t^b + u(q_t)$

‣ Sellers: can produce the DM good $\qquad U^s = x_t^s - w(q_t)$

  ‣ each is randomly matched in the DM with prob. α

‣ No bilateral credit in DM trades (due to anonymity)

‣ 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

‣ A buyer learns type of meeting in advance

  ‣ exits the CM holding either cash or deposits

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)

▸ Digital currency earns nominal interest rate $1 + i_E$

   ▸ financed as needed by lump-sum taxes/transfers

 $\Rightarrow$ represents the consolidated public sector

▸ Welfare:

$$\sum_{t=0}^{\infty} \beta^t \left\{ x_t^b + x_t^s + x_t + \alpha \begin{bmatrix} \lambda_1 \left(\textcolor{red}{\nu}\, u(q_{1t}) - w(q_{1t}) \right) \\ + \lambda_2 \left(u(q_{2t}) - w(q_{2t}) \right) \end{bmatrix} \right\}$$

   ▸ consumption in type 1 meetings may be discounted ($\nu < 1$)

   ▸ reflects illegal/undesirable activities (as in Williamson, 2012)

3. Equilibrium (without CBDC)

Cash meetings

▸ Buyer entering a cash meeting chooses m_t based on real return $1 + r_M$ $\left(= \dfrac{p_t}{p_{t+1}} \right)$

   ▸ increasing; vertical at $1 + r_M = \dfrac{1}{\beta}$

▸ 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

▸ Completely standard …

   ▸ *except*: welfare is $\left(\nu\, u(\, q_{1t}) - w(q_{1t}) \right)$
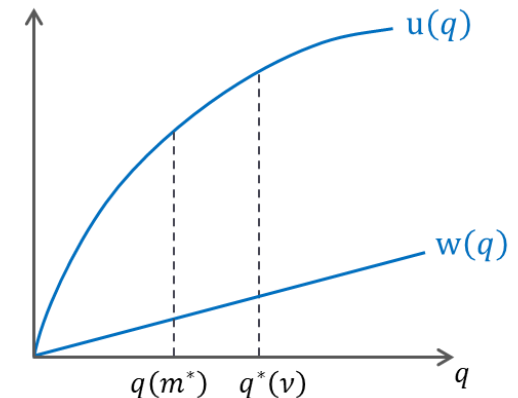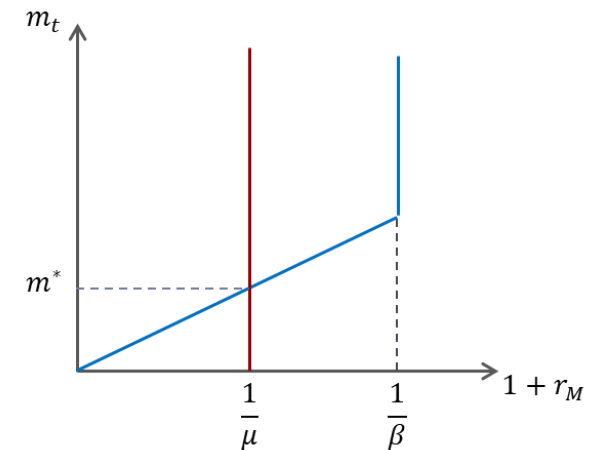
Deposit meeting
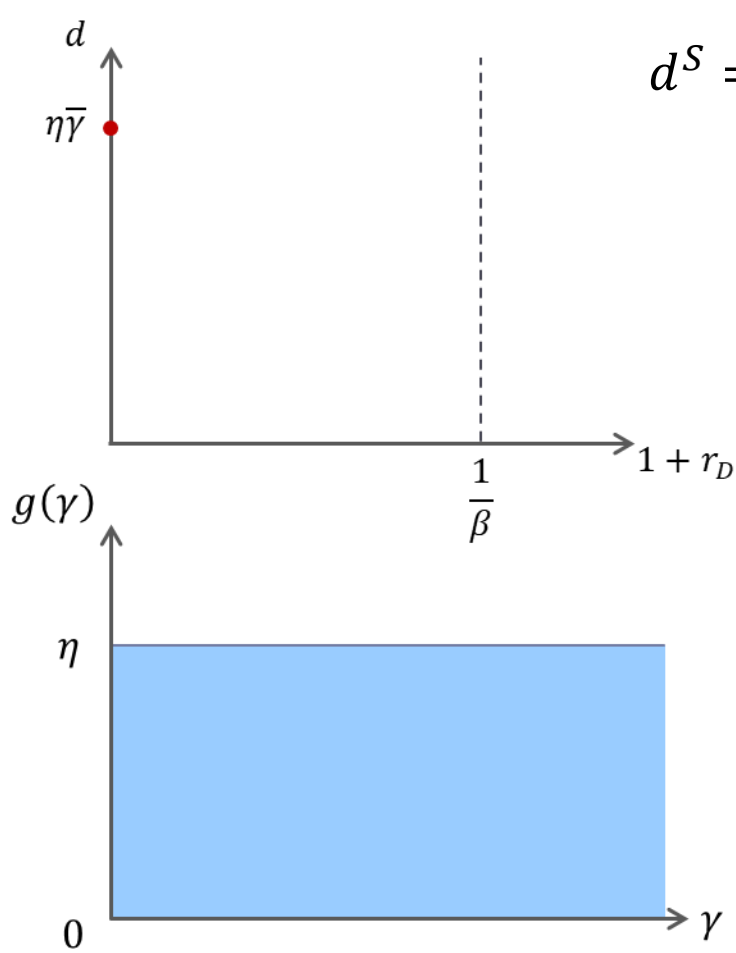
▸ Buyer entering a deposit meeting chooses d_t based on rate of return

  ▸ increasing; vertical at $1 + r_D = \frac{1}{\beta}$

▸ Supply of deposits from banks will determine $1 + r_D^*$

  ▸ and equilibrium real balances d^*

▸ Real deposits determine the amount of DM production, trade
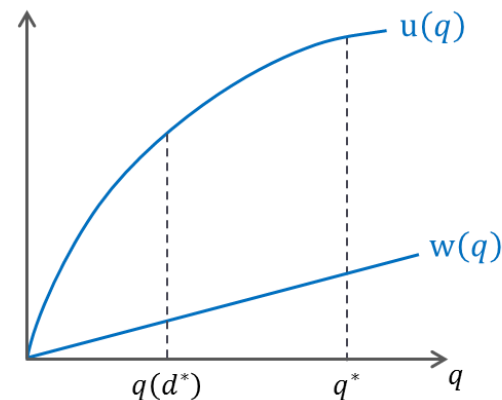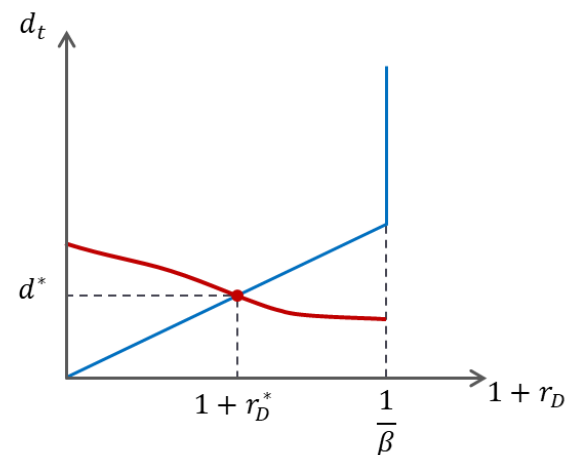
Q: What determines the supply of deposits?

Supply of deposits

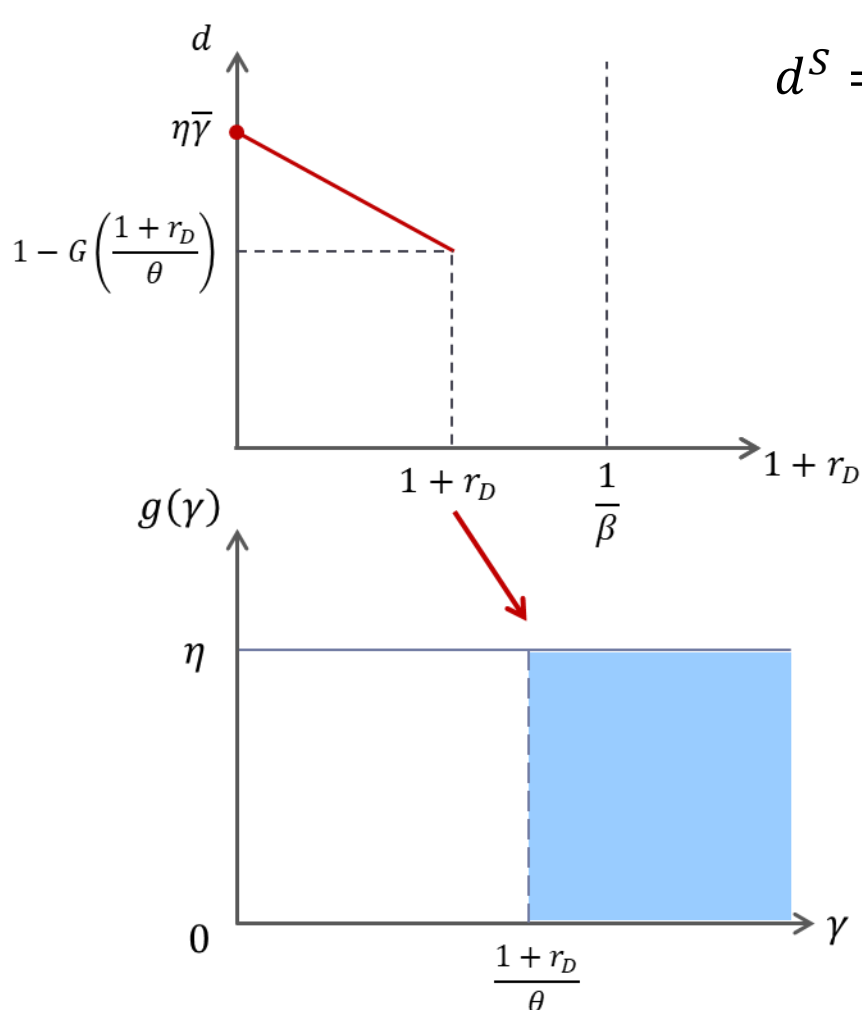▸ Supply of deposits depends on the distribution of projects
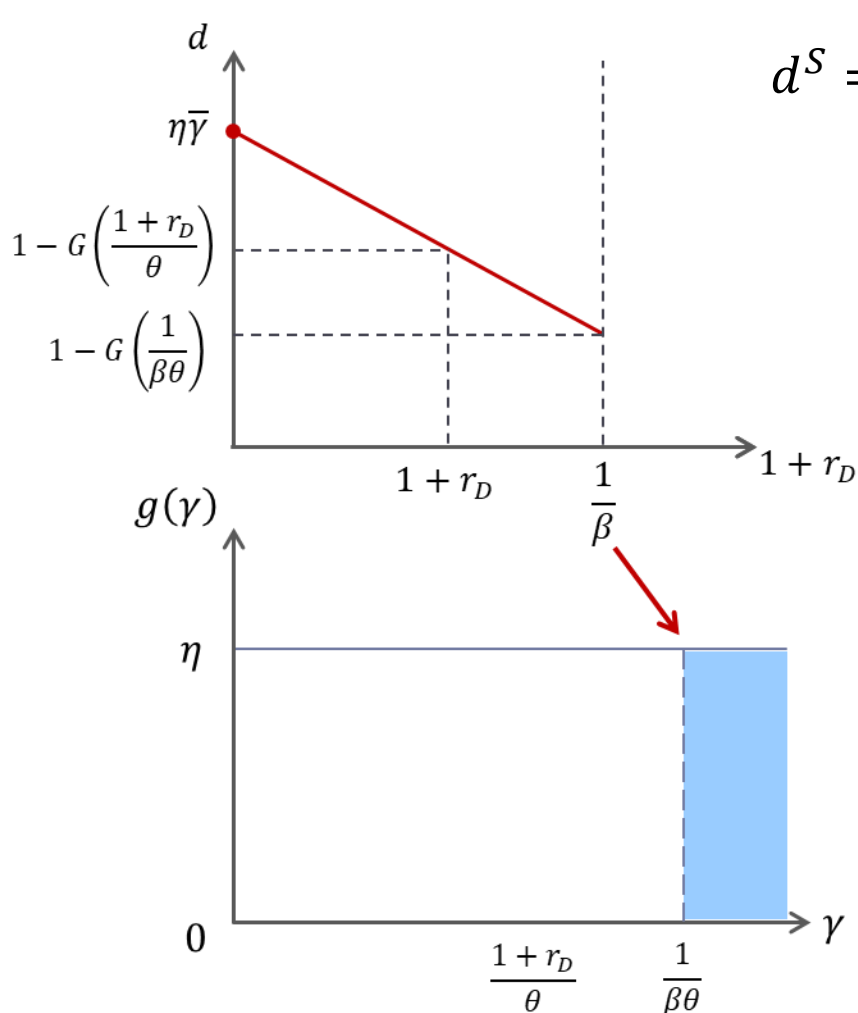

$$d^S = G(\bar{\gamma}) - G\left(\frac{1 + r_D}{\theta}\right)$$

▸ When $1 + r_D = 0 \Rightarrow$ all projects are funded

  ▸ supply of deposits is $d^S = G(\bar{\gamma})$

Supply of deposits

▸ Supply of deposits depends on the distribution of projects

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

▸ When $1 + r_D = 0 \Rightarrow$ all projects are funded

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▸ As r increases, fewer projects are viable

  ▸ bankers issue fewer deposits

Supply of deposits

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▸ As r increases, fewer projects are viable

  ▸ bankers issue fewer deposits

  $\Rightarrow$ supply curve slopes downward

  shape depends on distribution G

Equilibrium

If high-return projects are scarce:

▸ $1 + r^* < \frac{1}{\beta}$ (liquidity premium)

  ▸ deposits are "low-cost funding"

▸ d^* small → inefficient exchange
      (not pictured)

▸ Interpretation:

  ▸ banks' access to low-cost funding …

  ▸ … helps offset the θ friction
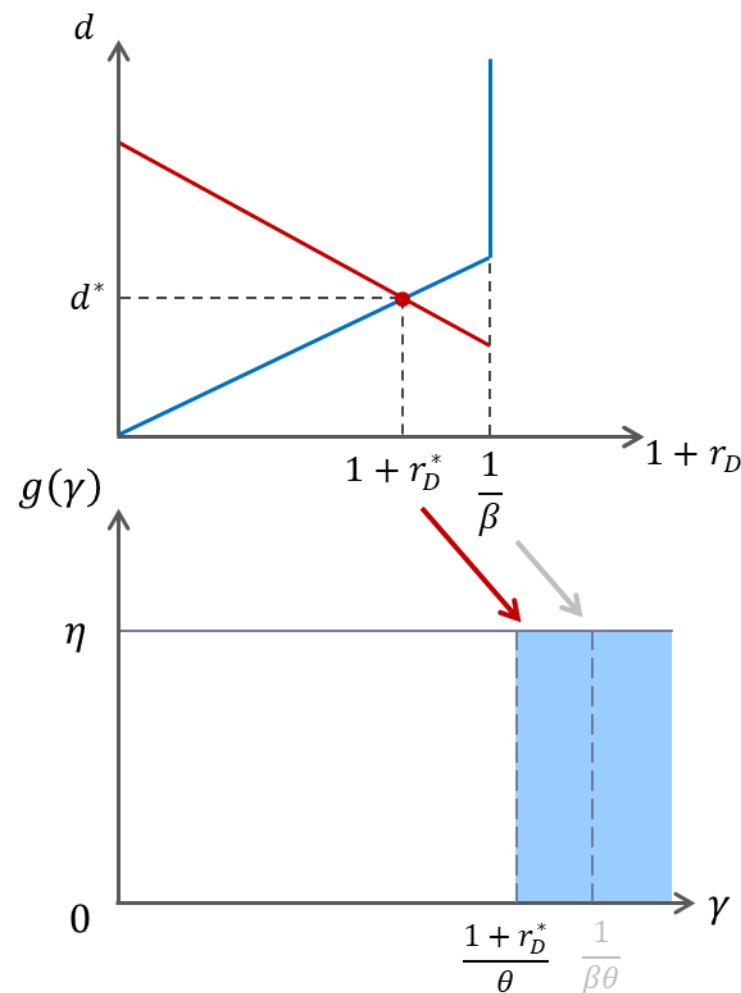
Note: if $\theta = 1 \Rightarrow$ investment cutoff is <u>below</u> the first-best

4. Introducing CBDC

What is a CBDC?

▸ CBDC is a new form of outside money

   ▸ CB willing to exchange 1-for-1 with physical currency in CM

   ▸ earns interest at rate i_E (positive or negative) set by CB

▸ Key question: in what meetings can it be used?

   ▸ partly a technological question; answer is currently undecided

1. A *restricted-use* CBDC can only be used in one meeting type

   ▸ *cash-like*: restrict size of holdings, methods of transfer

   ▸ *deposit-like*: account-based; uses existing payment network

2. If CBDC is *universal*, it can be used in all meetings

▸ In each case: should the CB introduce digital currency?

   ▸ if so, how should the interest rate be set?

Effect on asset demand

▸ If CBDC is cash-like and $r_M < r_E$: households hold no currency

  ▸ shift entirely into CBDC

cash-like
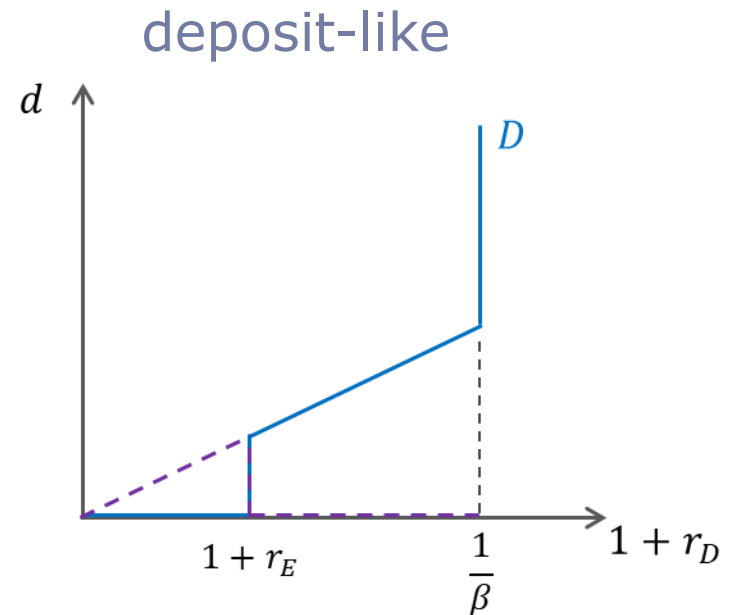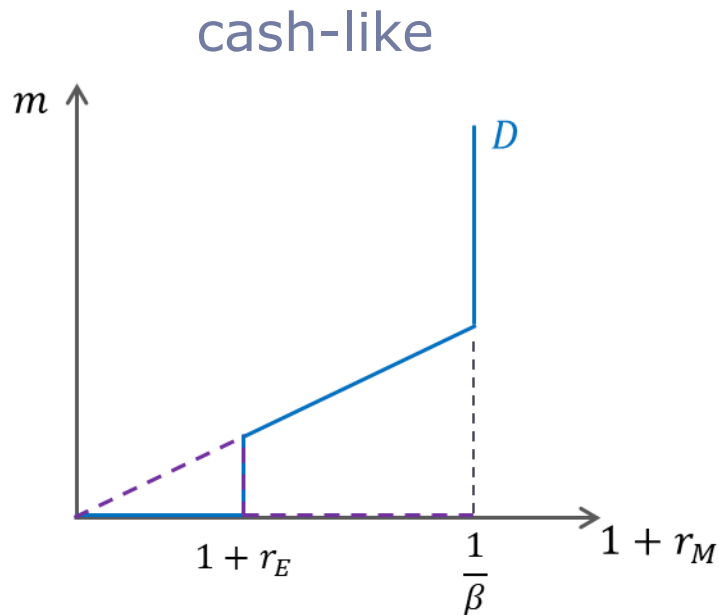
deposit-like

▸ If CBDC is deposit-like: similar effect of deposit demand

▸ If CBDC is universal: creates *both* lower bounds

Effect on cash meetings

If $1 + r_E > \frac{1}{\mu}$:

  ▸ buyers switch from cash to CBDC

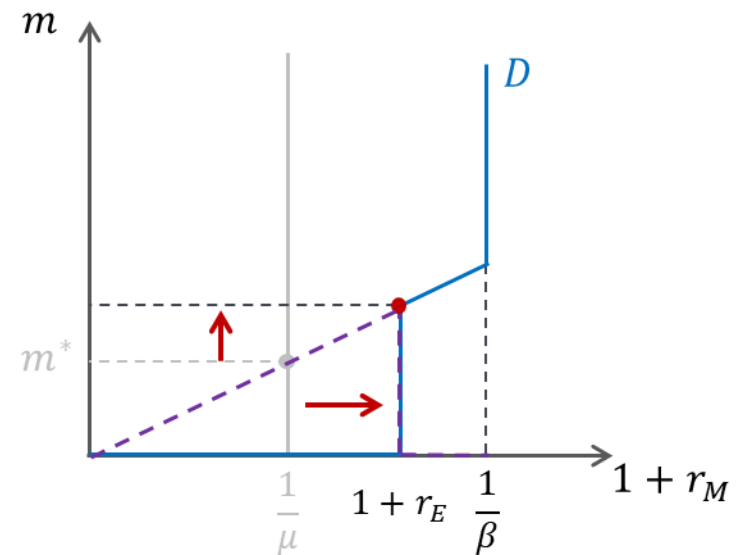 ▸ quantity of DM trade increases

Q: Is this good for welfare?

A: Depends on ν

Proposition: There exists $\bar{\nu} \in (0,1)$ such that a cash-like digital currency is desirable if and only if $\nu > \bar{\nu}$.

▸ In this case, the optimal interest rate is:

$$1 + i^C = \frac{\mu}{\beta} \frac{\nu}{\alpha + (1-\alpha)\nu}$$
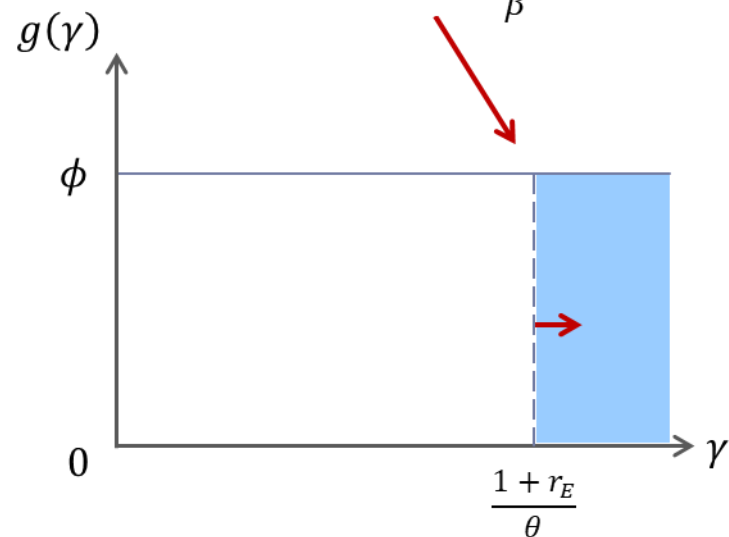
  ▸ a modified Friedman rule (to allow for $\nu < 1$)
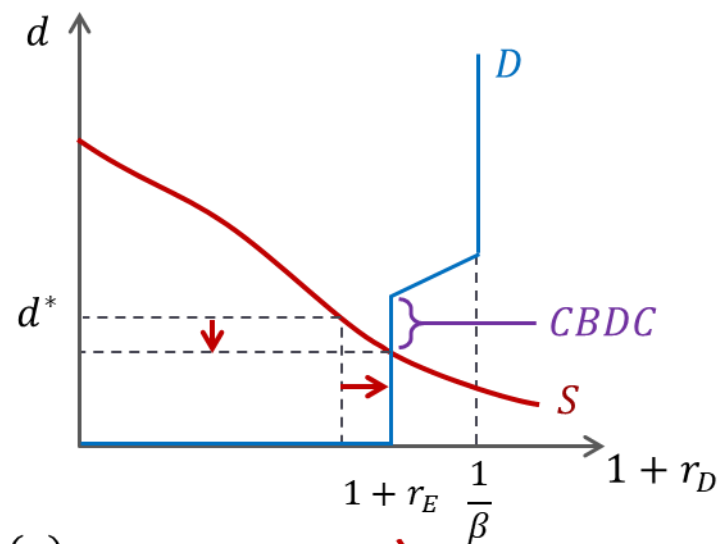
Effect on deposit meetings

If $1 + r_E > 1 + r_D^*$:

▸ deposit rate increases to $1 + r_E$

▸ quantity of deposits falls

▸ investment cutoff $\hat{\gamma}$ increases

   ▸ quantity of bank investment falls

   ➡ "disintermediation" arises

However:

▸ Total liquid balances (deposits plus CBDC) <u>increase</u>

   ⇒ increased DM exchange (good)

Results

Proposition: There exists $\bar{\eta} > 0$ such that a deposit-like digital currency is desirable if $\eta < \bar{\eta}$.

▸ Intuition: If high-return projects are in scare supply …

  ▸ and, therefore, the liquidity premium on deposits is large enough

▸ … then a deposit-like digital currency can raise welfare

▸ If the economy with no CBDC has overinvestment $\left(\hat{\gamma} < \frac{1}{\beta}\right)$ …

  ▸ a deposit-like digital currency can always raise welfare

  ▸ because disintermediation in this case is *good*

▸ When a deposit-like CBDC is desirable, the optimal policy creates some (bad) disintermediation

  ▸ at $\hat{\gamma} = \frac{1}{\beta}$, the welfare cost of disintermediation is second-order

An example

(a) real interest rate
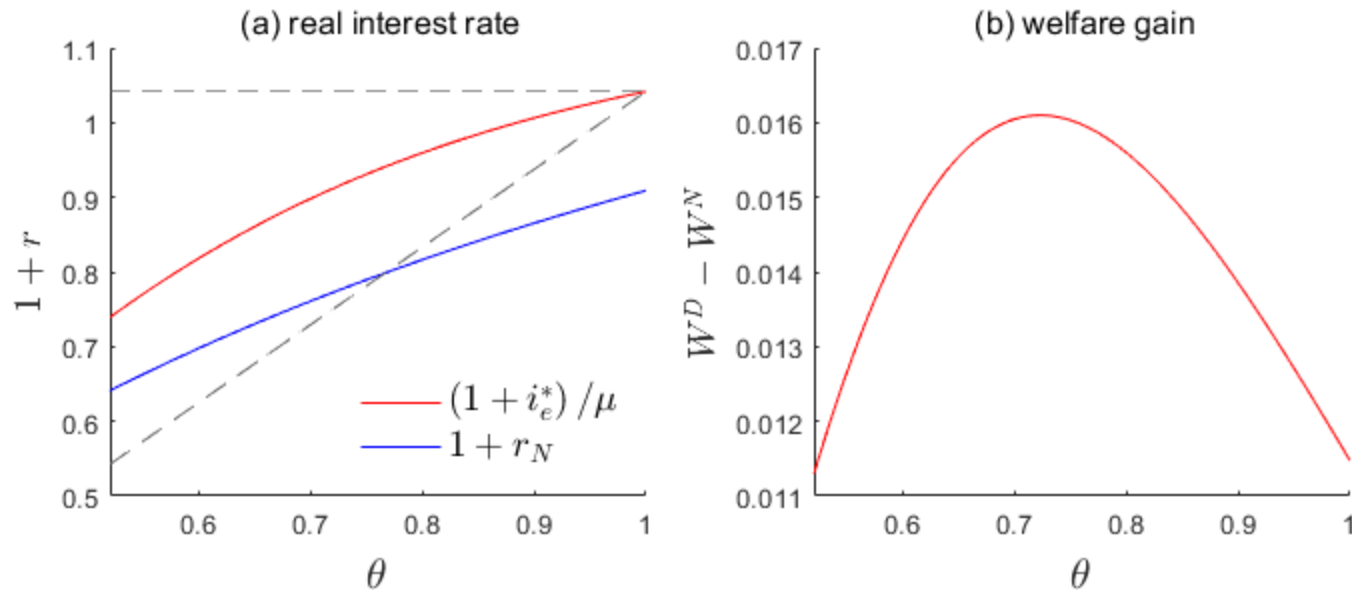
(b) welfare gain

- ▸ Illustrates two general points:

  - ▸ optimal interest rate converges to $\frac{\mu}{\beta}$ as $\theta \to 1$

  - ▸ welfare gain is largest for intermediate values of θ

    - ▸ when θ is small, disintermediation is very costly

    - ▸ when θ is large, lower liquidity premium $\Rightarrow$ less benefit from CBDC

Optimal policy

▸ If restricted-use CBDCs are feasible, the optimal policy is

(a) $\eta = 0.7$ (b) $\eta = 0.8$ (c) $\eta = 0.825$

● cash-like   ● deposit-like   ● both
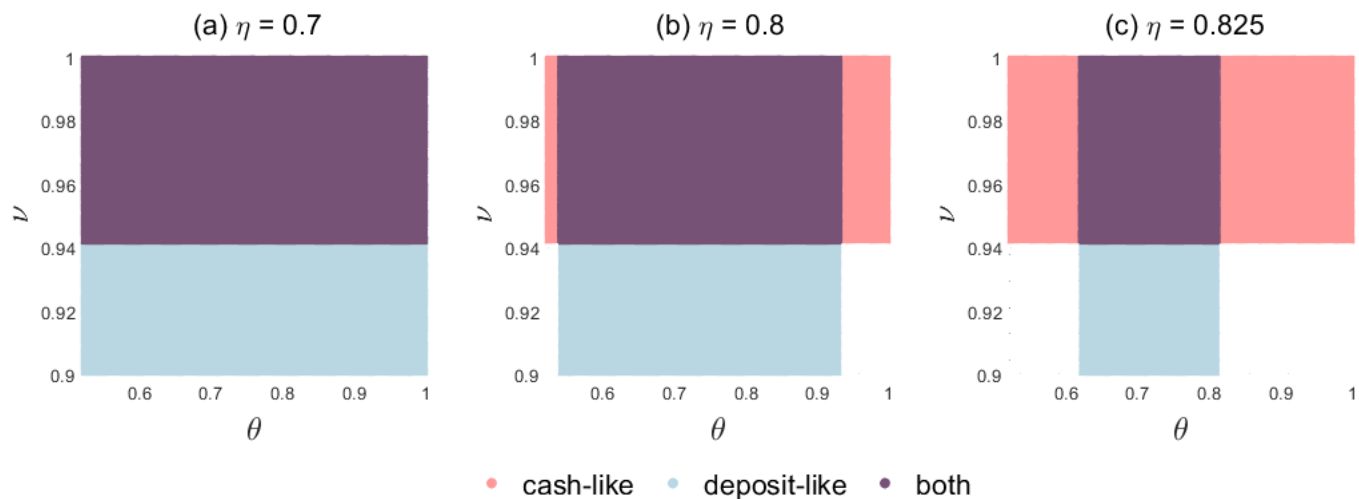
▸ Note: the two types of CBDC often have (very) different interest rates

    ▸ important that use is *restricted*

▸ What if any CBDC can be used in all meetings?

$1 + i^C$
$1 + i^D$
$1 + i^U$
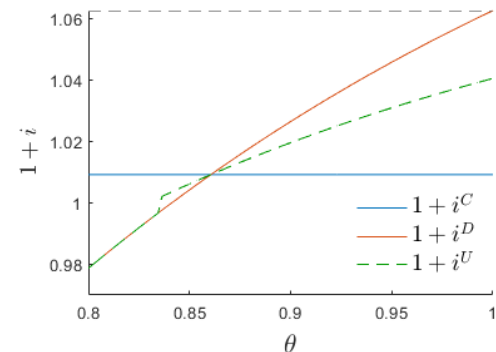
Universal CBDC

▸ Suppose the CB is unable to restrict CBDC use by meeting type

   ▸ CBDC is by definition both *currency* and *digital*

   $\Rightarrow$ perhaps all sellers are able to accept it

▸ Optimal policy problem has the same form as before …

   ▸ central bank sets the CBDC interest rate for each type of meeting

▸ … but with an additional constraint:

   ▸ the two CBDC rates must be equal

▸ In some cases, the new constraint is not binding (Prop. 6)

   ▸ no incentive for buyers to deviate to a higher-yielding CBDC

▸ If the constraint binds, the welfare gain from CBDC is smaller

Proposition: There exists $\bar{\eta}^U > 0$ such that a deposit-like digital currency is desirable if $\eta < \bar{\eta}^U$.

▸ still the case that a CBDC is desirable when the liquidity premium on deposits is large enough

▸ In these cases, the constraint affects <u>how</u> the CBDC is used

▸ A universal CBDC may circulate less widely …

  ▸ in some cases where both restricted-use CBDCs are desirable

  ▸ a universal CBDC is used only in one type of meeting

▸ … or <u>more</u> widely

  ▸ in some cases where only one restricted-use CBDC is desirable

  ▸ a universal CBDC is used in both types of meetings
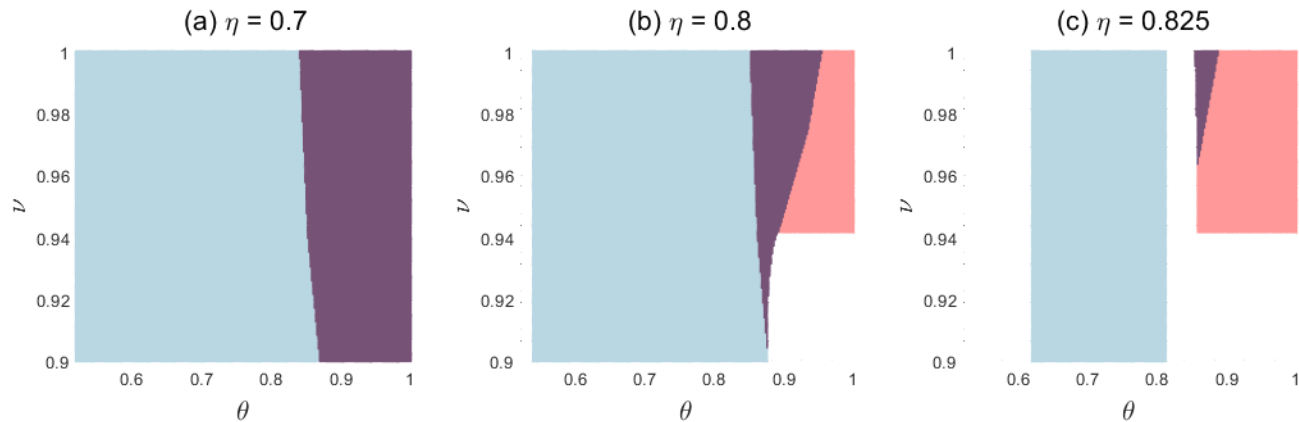
Comparing usage

▸ Restricted-use:

(a) $\eta = 0.7$ (b) $\eta = 0.8$ (c) $\eta = 0.825$
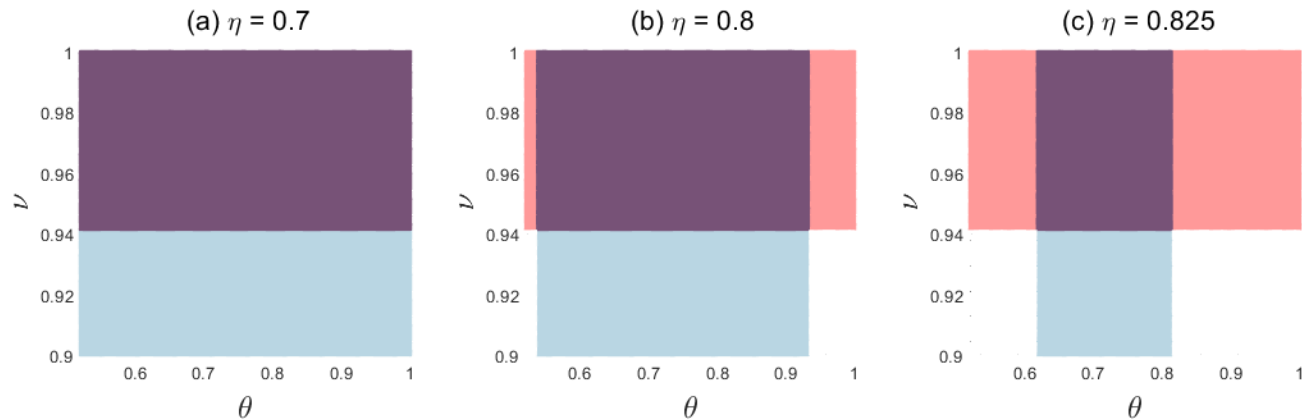
● cash-like   ● deposit-like   ● both

▸ Universal:

(a) $\eta = 0.7$ (b) $\eta = 0.8$ (c) $\eta = 0.825$

● used in type 1 meetings   ● used in type 2 meetings   ● used in both types of meetings

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4. Concluding remarks

Concluding remarks

Q: Should central banks issue digital currency?

- We provide a framework for answering this question

  - captures key concerns expressed by policy makers

- In some ways, our framework is biased *against* CBDC

  - banking sector is competitive → disintermediation concern strong

- Nevertheless, we show that answer is often 'yes'

  - key insight: interest rate on CBDC is a new, useful policy tool

- Caution: CB must choose design, interest rate appropriately

  - optimal i can be positive or negative

  - arbitrary choices can easily decrease welfare