Central Bank Accounts For All!

(And when they do any good.)

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Motivation

Why talk about it?

- Digital currency issued by central bank could effectively work as central bank account for all.
  - Current policy interest (BIS, Bank of England, Bank of Canada, Swedish Riksbank)
- Besides 100% Reserve Banking way to prevent banks form creating money.
  - Benes Kumhof (2012) argue 100% reserve banking is the same as CBDC.
  - Referendum in Switzerland ("Vollgeld").
  - Debate in Icelandic parliament.
  - "Chicago Plan" as response to banking crisis in 1930s.

Motivation

The version of CBDC in this paper:

- Government only guarantees CBDC with capacity to tax, not deposits at banks.
- Government receives deposits from households, and hands them over to banks.

Literature

Who else talks about it?

- Setting the stage.
  - Brunnermeier and Niepelt (2019).
- Central bankers.
  - Coeure and Loh (2019), Engert and Fung (2017)
- People not primarily concerned about banks' incentives.
  - Piazzesi and Schneider (2020), Bech and Garratt (2017), Chapman Wilikns (2018), Andolfatto (2018), Keister and Sanches (2019)
- Chicago plan enthusiasts.
  - Benes and Kumhof (2012), Fisher (1936), Simons (1946)
- Narrow banking pro-/op-ponents.
  - Kay (2009), Wallace et al. (1996)
- Central bank accounts for all and maturity transformation.
  - Fernandez-Villaverde et al. (2020).

Preview of Results

What Friction?

- Deposit insurance leads to over-investment.

Can CBDC Achieve First Best?

- No, if households get paid before the government by defaulting bank.
- Achieves first best if
  1. households and government receive money "at the same time" when bank defaults.
  2. last dollar of loans receives the output it creates as collateral.

Preview of Results

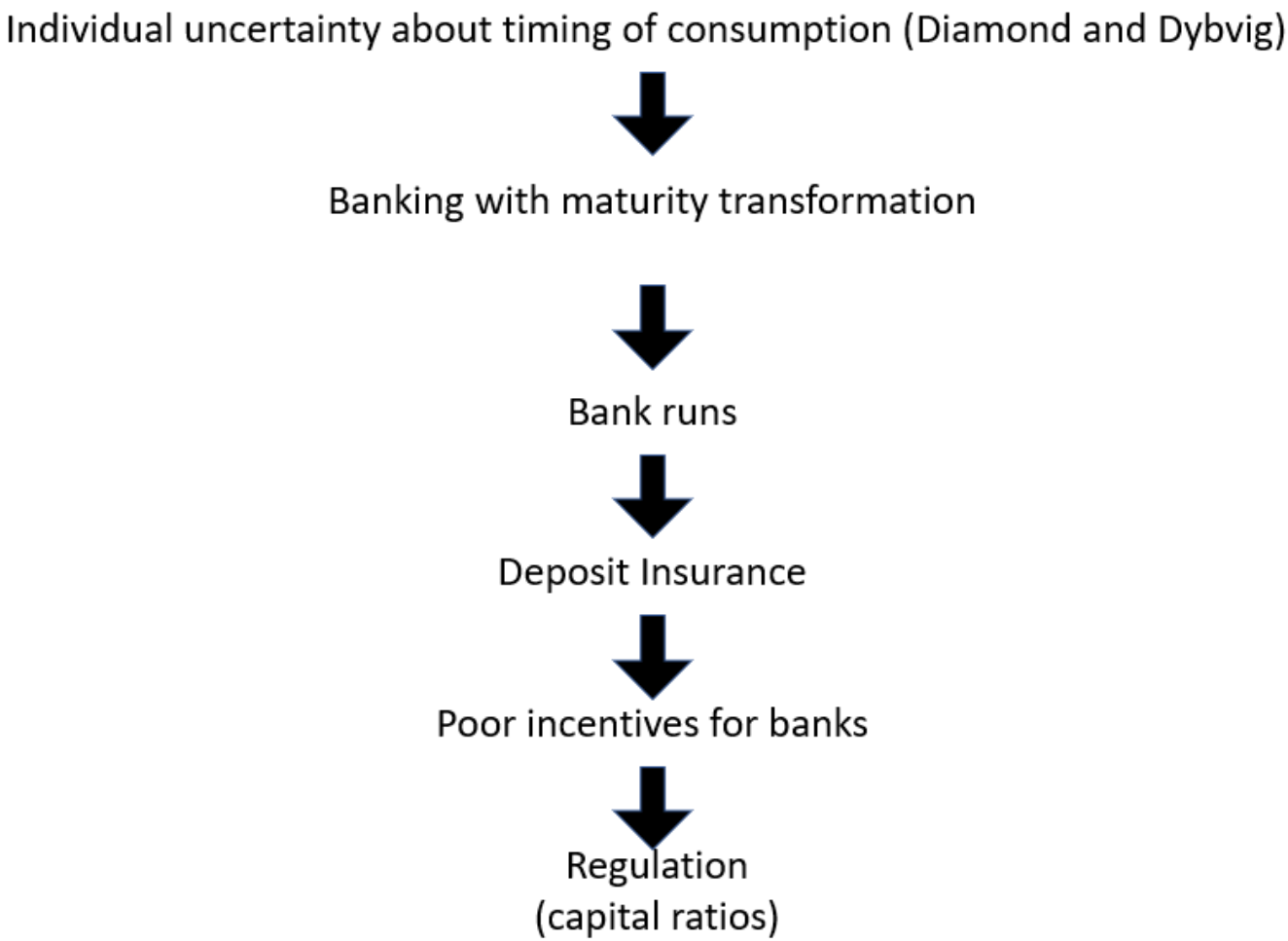

Figure 1: Big Picture.

Outline

Plan

1. Main Mechanics.
   - 1.1 Derive what governs efficiency in general setup.
   - 1.2 Describe efficiency in different cases.
   - 1.3 Discussion.
2. Big picture.

Setup

Basic Setup

- Two periods, household, bank.
- Only household consumes.
- Bank produces and tries to act in household's interest.
- Bank finances itself with deposits (d) and loans (s).

Setup

Notation

- What household receives in state ω if it invests d in deposits and s in loans at interest rates r:

$$t_h(r, s, d, \omega)$$

- What bank pays in state ω if it receives d in deposits and s in loans at interest rates r:

$$t_b(r, s, d, \omega)$$

- Can differ because of deposit insurance.
- Can differ because household gives deposits to government, who hands them on to banks.

Setup

What determines level of investment?

- Level of deposits effectively set by government.
  - With deposit insurance deposits better for household than loans because insured.
    $\Rightarrow$ Free to choose deposits by setting how much deposits are insured.
  - With CBDC government sets a different interest rate for household and banks.
    $\Rightarrow$ Free to choose deposits by setting interest rate for household.

Takeaway

- Deposits are effectively fixed.
- Overall investment governed by incentive to invest in loans.

Money, Money, Money

Social Planner

- Problem:

$$u_0(n_h + n_b - a) + \int u(f(a)\omega)dH(\omega)$$

- FOC:

$$u_0'(n_h + n_b - a) = \int u'(f(a)\omega)f'(a)\omega dH(\omega)$$

- Look at cases in which FOC is sufficient for optimum.

Money, Money, Money

Household

- Problem:

$$\max_{d,s} u_0(n_h - s - d) + \int u(t_h(r, s, d, \omega) - \tau(\omega) + \pi(\omega))dH(\omega)$$
$$+ \left\{\lambda(\overline{d} - r_d d)\right\}$$

Money, Money, Money

Household

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$$\max_{d,s} u_0(n_h - s - d) + \int u(t_h(r, s, d, \omega) - \tau(\omega) + \pi(\omega))dH(\omega) + \left\{\lambda(\overline{d} - r_d d)\right\}$$

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Money, Money, Money

Household

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Bank

- Problem:

$$\max_{d',s'} u_0(n_h - s - d) + \int u(\iota(\omega) + f(n_b + d' + s')\omega - t_b(r, s', d', \omega))dH(\omega)$$

Money, Money, Money

Household

- Problem:

$$\max_{d,s} u_0(n_h - s - d) + \int u(t_h(r, s, d, \omega) - \tau(\omega) + \pi(\omega))dH(\omega) + \left\{\lambda(\overline{d} - r_d d)\right\}$$

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$$\max_{d',s'} u_0(n_h - s - d) + \int u(\iota(\omega) + f(n_b + d' + s')\omega - t_b(r, s', d', \omega))dH(\omega)$$

- FOC:

$$\int u'(f(a)\omega)\frac{\partial t_b(\omega)}{\partial s}dH(\omega) = \int u'(f(a)\omega)f'(a)\omega dH(\omega)$$

Money, Money, Money

Reminder:

$$u_0'(n_h - s - d) = \int u'(f(a)\omega)\frac{\partial t_h(\omega)}{\partial s}dH(\omega)$$

$$\int u'(f(a)\omega)\frac{\partial t_b(\omega)}{\partial s}dH(\omega) = \int u'(f(a)\omega)f'(a)\omega dH(\omega)$$

Consequence:

- If $t_b'(\omega) = t_h'(\omega)$ we get the efficient outcome.
- If $t_b'(\omega) \leq t_h'(\omega)$ and sometimes the equality is strict, then we get over-investment.

Money, Money, Money

Important Takeaway:

- Ignore optimization problem. Just look at whether what the household gets from last dollar invested is what the bank pays for it.

Lemma (Efficiency)

If the planner's problem is convex and the FOCs for loans hold with equality

- *the allocation is efficient if* $\frac{\partial}{\partial s} t_b(\omega) = \frac{\partial}{\partial s} t_h(\omega)$
- *there is over investment if* $\frac{\partial}{\partial s} t_b(\omega) \leq \frac{\partial}{\partial s} t_h(\omega)\ \forall \omega$ *and the inequality is strict with positive probability*
- *there is under-investment if* $\frac{\partial}{\partial s} t_b(\omega) \geq \frac{\partial}{\partial s} t_h(\omega)\ \forall \omega$ *and the inequality is strict with positive probability*

in equilibrium.

Results for Baseline

Baseline

- Deposit insurance.
- Loans are collateralized /have precedence in times of default.

When are slopes of Transfer functions different?

- ω such that bank defaults on deposits, not on loans.
- One additional dollar invested in loans receives full interest rate so $t_h'(\omega) = r_s$.
- Bank pays everything it has, so additional payment by bank is $t_b'(\omega) = f'(a)\omega$.
- The second is smaller than the first in default.

Consequence

- Over-investment.

Result for CBDC WithOUT Bank Reform

CBDC without bank reform

- In default loans have precedence.

When are slopes of Transfer functions different?

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Consequence

- Over-investment.

CBDC WithOUT Bank Reform vs Baseline

Proposition (CBDC without Bank Reform versus Baseline)

If there is an equilibrium with investments d^*, s^* in the model with deposit insurance for some $\overline{d}$ then for some r_d^h there is an equilibrium in the model with CBDC for which equilibrium investment is d^*, s^* and vice versa.

CBDC With Bank Reform

CBDC with bank reform

- Household and government paid at same time.
- Last dollar of investment receives collateral it creates.

Transfer functions are the same.

- No default: no problem.
- Default on household and central bank:
  - Last dollar receives its marginal product as collateral, thus household receives marginal product, and bank pays it.
  - $t_h'(\omega) = t_b'(\omega)$.
- Bank defaults on government and not on household debt.
  - Cannot happen by assumption.

Consequence

- Efficient solution.

Is This Feasible?

When do banks default on government and household simultaneously?

- If banks can pledge high quality collateral, then other lenders have precedence over government.
- If banks do maturity transformation, non-government creditors are likely to run first.
- If banks get bailed out when they default this is effectively the same as deposit insurance.

How do we implement optimal bank reform?

- Implementation of optimal bank reform difficult.
- I characterize it, but I do not provide a mechanism (transfer function depends on equilibrium objects).
- But: requiring risky collateral from banks leads to second best.

Outline

Plan

1. Main Mechanics.
2. Big picture.
   - Model
   - Forces
   - Outcomes

Big Picture

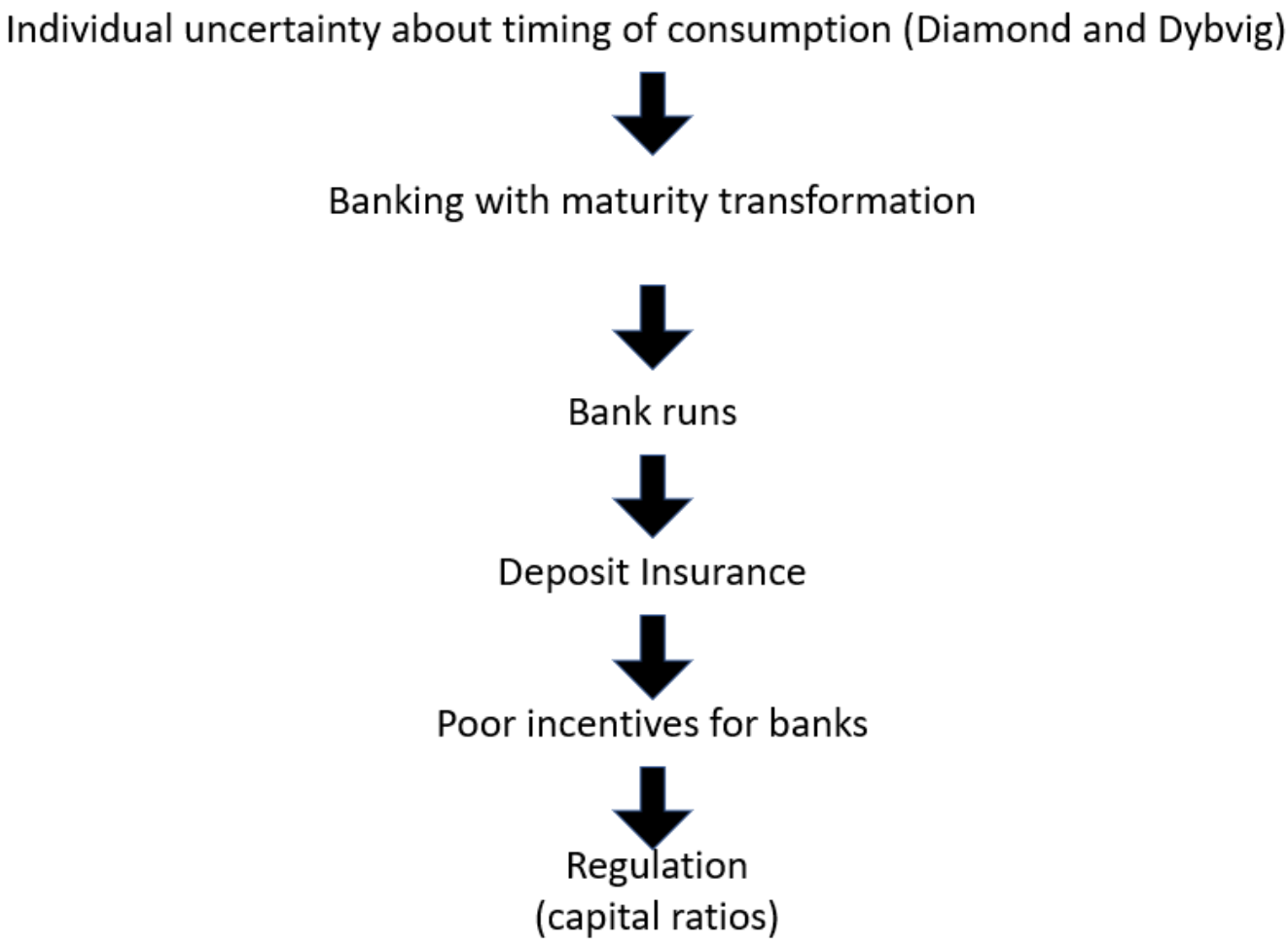

Figure 2: Big Picture.

Model Overview

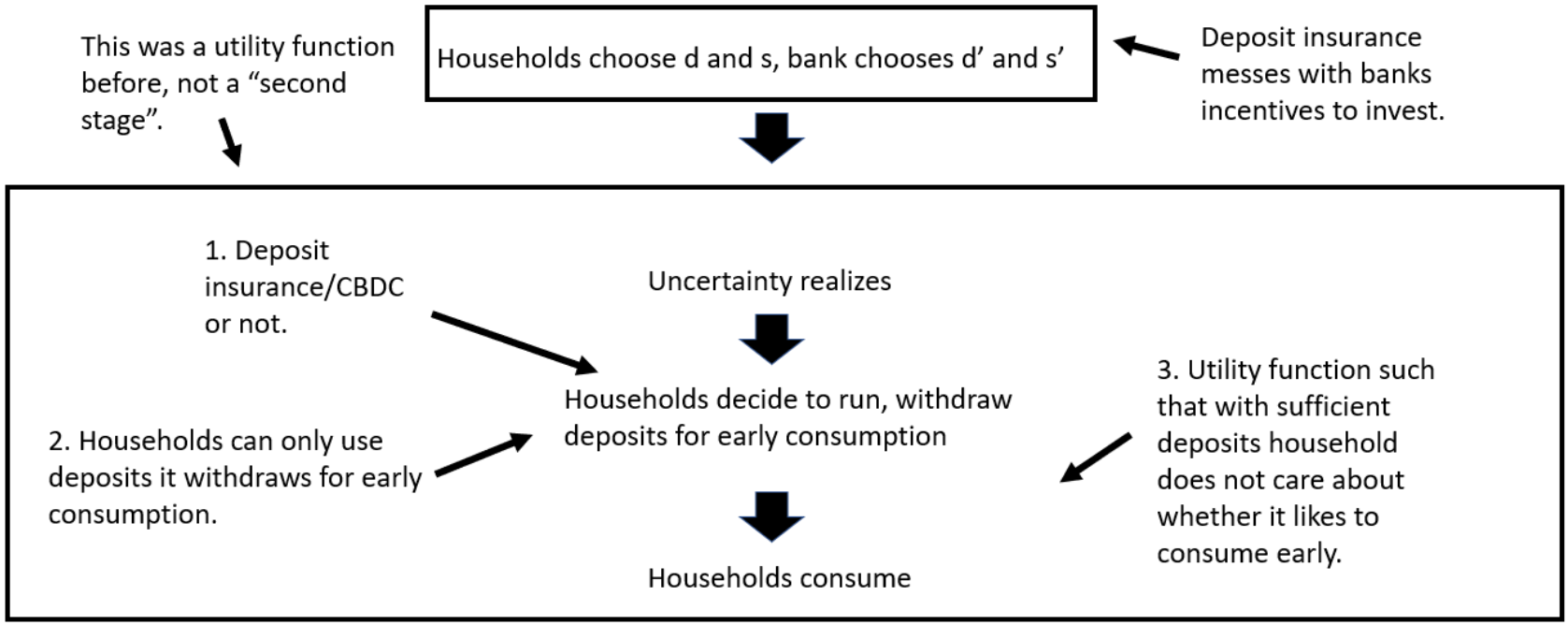

Figure 3: Model Overview.

- Now two households and two banks.
- Some deposits have precedence in times of default because they are withdrawn.
- Production is linear.

Equilibrium

Equilibrium

- In second stage households choose to withdraw deposits maximizing utility.
- In second stage banks maximize value of assets.
- In first stage bank/household optimize as before.

Second Stage

Banks in Second Stage

$$\max_{\Delta} A_2\omega(a - \frac{1}{A_1\omega}\Delta) + p\Delta.$$

- Might already know that they will default, and thus maximize value of their assets.
- Liquidating deposits results in payoff $A_1 < A_2$.
- Equivalent to having banks and households optimize to reinvest deposits.

Second Stage

Household Second Stage

$$\max_{\Delta \in \mathcal{D}} U(c_e, c_l, \psi) + \lambda(-c_e + \Delta) + \mu(m - pc_e - c_l)$$

- $0 = \psi$: household only wants to consume late: $U = c_l = m$.
- $1 = \psi$: household wants to consume share of its income early until income hits threshold, then wants to consume everything above threshold late.
  - Ensures that if limit on $r_d d$ high enough there are always enough deposits.
  - Ensures that if there is no run only fraction of deposits is withdrawn.
  - Scale utility function such that it becomes

$$U(c_e(m), c_l(m), 1) = m$$

    if liquidity constraint does not bind.

$\Rightarrow$ with sufficient deposits liquidity disappears.

Forces

Forces in the model

- What banks pay is not what households receive.
- Runs on deposits.

Forces shut down

- Inefficient incentives of banks who know they will default.
- Runs on anything but deposits.
  - Only deposits are run-able (not financial crisis like).
  - Avoids that CBDC with bank reform shuts down runs on loans in addition to fixing bank's investment incentives.
- "Collateral externalities" (changing my investment creates/takes away collateral for others/ other types of lending).
  - Still anticipate that investing in loans creates collateral that backs these loans.
  - Still anticipate that when there's a run on deposits loans might receive zero.

Outcomes

No Deposit Insurance

- Keep limit on deposits to make models comparable.
- Set deposits high enough such that liquidity considerations no concern.
- Runs result in effectively lower production.
- If there is a default and banks get run at there might be no deposits left that can be used to pay back loans.
- Slope of transfers paid by bank's sometimes higher than slopes of transfers received by households.

$\Rightarrow$ Lower investment than in planner's problem with inferior production technology.

Outcomes

Shrinking the model

- Set level of deposits such that
  - there is sufficient liquidity to finance optimal early consumption.
  - there are not enough deposits to finance optimal investment.
- Liquidity disappears from the model, and loans determine level of investment.
- Model reduced to the one previously studied (one extra parameter).

Outcomes

- Deposit insurance $\Rightarrow$ Over-investment.
- CBDC and no bank reform $\Rightarrow$ Over-investment.
- CBDC and bank reform $\Rightarrow$ Optimal allocation.

Why?

- Same arguments as in first version of the model.

Outcomes

Leverage constraint and Deposit Insurance

- Two choice variables (loans and deposits), two policy tools (level of deposits, leverage constraint).
- Set deposits to anything that provides sufficient liquidity in every state, and set them lower than optimal investment.
- Set investment using leverage constraint.

$\Rightarrow$ Optimal solution.

Wrapping Up

Issues

- Why CBDC if we can use leverage constraints?
  - Optimal leverage constraint requires knowledge of optimal investment.
  - CBDC requires knowledge about how much liquidity is needed.

  $\Rightarrow$ nationalizing liquidity provision lets market set investment.
  - Neither CBDC nor leverage constraints without problems.

  $\Rightarrow$ Question is which works better.
- Why is CBDC essential? Bank reform without CBDC possible?
  - Effectively bank reform without CBDC requires limit on amount of money one can deposit in bank.
  - CBDC provides opportunity for bank reform.
  - Requiring collateral from banks plausible when CBDC introduced.

Wrapping Up

Can CBDC Achieve First Best?

- No, if households get paid before the government by defaulting bank.
- Achieves first best if
  1. households and government receive money "at the same time" when bank defaults.
  2. last dollar of loans receives the output it creates as collateral.
- First best CBDC
  - is not obviously implementable.
  - would eliminate chain of inefficiencies and fixes in current system.

Thank you!