Central Bank Digital Currency and Monetary Policy

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Disclaimer: The views expressed in this paper are solely those of the author and no responsibility for them should be attributed to the Bank of Canada.

Introduction

- Many central banks are considering issuing CBDC (BIS, 2021)
  - a digital form of CB money that is widely accessible
- Even if CBDC is introduced, cash is expected to be around:
  - *"... Riksbank has a statutory requirement to issue banknotes and coins. I see e-krona primarily as a complement to cash."*
    Cecilia Skingsley, Deputy Governor of the **Riksbank**, 2016
  - *"The Federal Reserve is committed to ensuring the continued safety and availability of cash and is considering a CBDC as a means to expand safe payment options, not to reduce or replace them."*
    CBDC FAQ, **Federal Reserves**, 2022
  - "*In its role as the provider of Canadian bank notes, the Bank is working to ensure the processing and distribution of these notes is as efficient as possible. This will help make certain that cash remains a viable method of payment well into the future, ...*"
    Contingency Planing for a CBDC, **Bank of Canada**, 2019

What I Do

I study optimal monetary policy in the presence of cash and CBDC:

- CBDC:
  - Allows transfers contingent on balances
  - Fixed cost of carrying for agents: e.g., cost of losing anonymity
- Cash:
  - Contingent transfers NOT allowed
  - Zero cost

Takeaways

- CBDC provides **valuable information** such as agents' CBDC balances or CBDC flows
- CBDC enables governments/CBs to make potentially **non-linear balance-contingent** transfers
  - The **objective** here is to implement optimal MP but could be different, e.g., faster implementation of fiscal policy
  - Can be used for **cross-subsidization**
- Co-existence of cash and CBDC is often sub-optimal, because cash serves as an **outside option** for agents, limiting the MP benefits that CBDC could generate
- **Quantitatively**, if CBDC is about 0.25% more costly than cash, CBDC could lead to 0.12% increase in consumption for the US

Model Preview

- Two means of payments, cash and CBDC, used for consumption
  - CBDC holdings are observable while cash holdings are not
    - CBDC transfers: $t_e(z_e, w) \in \mathbb{R}_+$
    - Cash transfers: $t_c \in \mathbb{R}_+$
  - Cost of using CBDC is $K \geq 0$; for cash, it's 0

- Focusing on steady state equilibrium, the planner maximizes welfare by choosing: $\{\gamma_c, \gamma_e, t_c, \{t_e(z, w)\}\}$

Benchmark: Costless CBDC

- Efficiency requires the opportunity cost of holding money to be zero
  - Impossible with cash: because taxing cash holdings or communication with the planner is not possible
  - Possible with CBDC: the optimal scheme requires paying transfers only to agents who bring enough balances (for them to consume the first best)

- CBDC is useful for **cross-subsidization**, e.g., when low-value buyers don't achieve the first best but high-value buyers do

Costly CBDC

Suppose there are only two types, w_L w. p. $1-\pi$ and w_H w. p. π.

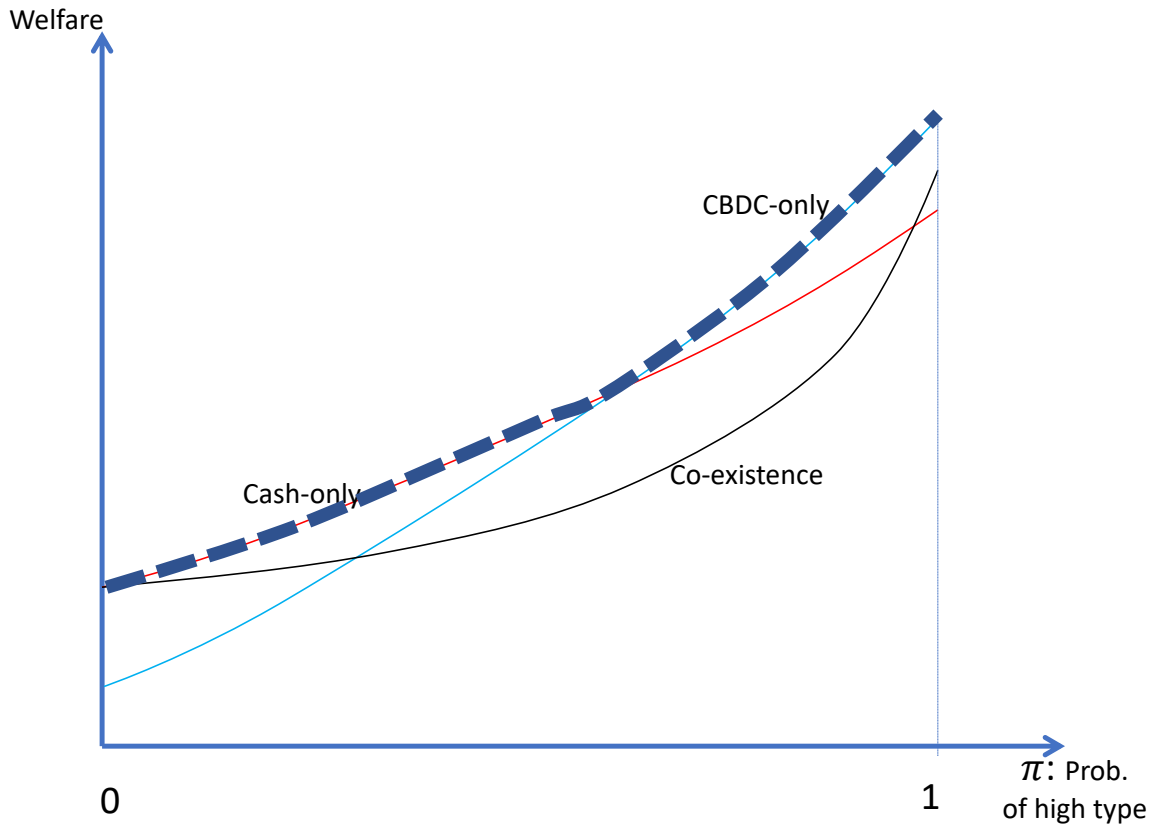
- **Cash-only**: 0 inflation, welfare loss due to opp. cost of holding cash
- **CBDC-only**: Less distortion, but direct cost K
- **Co-existence**:
  - Low cash-inflation: cash would be a good alternative for high-value users, prompting them to use cash instead
  - High cash-inflation: cash users are hurt

Hence, availability of cash poses a limit on the gains that can be achieved by CBDC

Proposition

*Under certain parameter restrictions, the **co-existence scheme is NOT optimal**.*

Costly CBDC


Welfare
CBDC-only
Cash-only
Co-existence
0
1
π: Prob. of high type

Calibration

Parameters	Var.	Value	Notes
Discount factor	β	0.97	standard in literature
Average markup	μ	20%	under 2% inflation
High/low value	z_2/z_1	2.009	avg. val. of debit/cash
Fraction of low type	π	0.464	vol. of cash trans./total vol.
Coeff. of type 1 utility	w_1	1.132	
Coeff. of type 2 utility	w_2	1.269	
Coeff. of CM consmp.	A	1.972	money demand curve
Curv. of DM consmp.	η	0.163	money demand curve
B's bargaining power	θ	0.870	money demand curve

Welfare Gains of CBDC

CBDC cost as a fraction of average transaction value (%)	Who uses CBDC?	Welfare gains of CBDC (%)	Welfare gains of CBDC (%) with 20% adoption
0.000	both	**0.250**	0.036
0.278	both	**0.121**	0.005
0.841	none	–	–

Table:

The gains are calculated relative to an economy with only cash under 0% inflation.

Low adoption: 80% of agents use only cash regardless.

Optimal Scheme

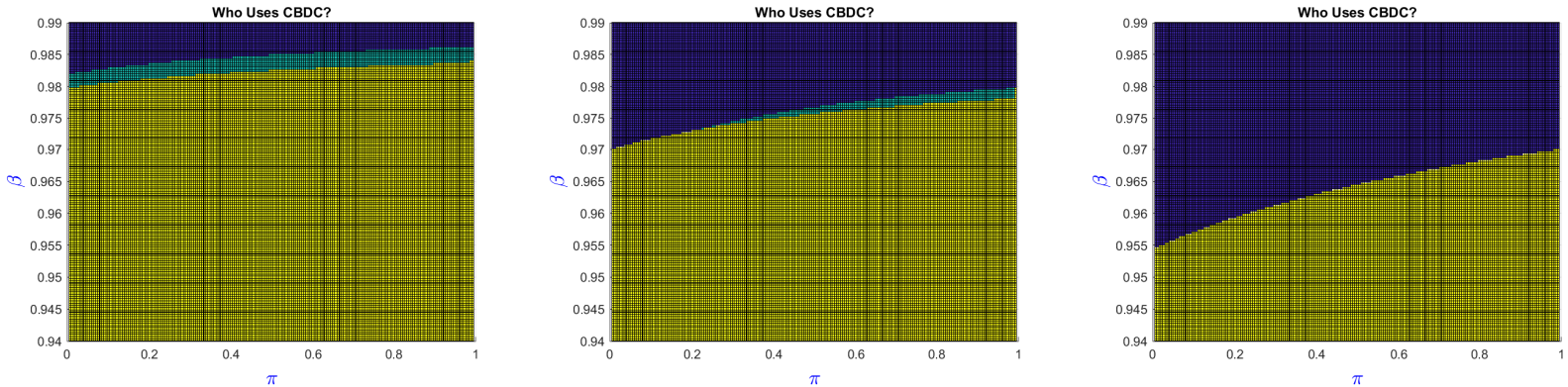


Figure: $K = 0.002$ (left), $K = 0.004$ (middle) and $K = 0.008$ (right).

Yellow: CBDC-only; Green: Co-existence; Blue: Cash-only.

Insights from Calibration

- Co-existence is often sub-optimal
- As π increases, CBDC is more likely to be used
- As β increases (i.e., real interest rate falls), cash is more likely to be used, because cash is less costly
- As CBDC cost increases, **co-existence** is less likely to be optimal
  - Higher $K \Rightarrow$ lower welfare under CBDC-only and co-existence schemes, but the effect of a tighter IC constraint is dominant
- Insights robust across alternative calibration parameters

Concluding Remarks

- CBDC is more powerful for MP implementation: e.g., non-linear interest payments
- Co-existence is often sub-optimal even though the first best requires co-existence
- Cash-only and co-existence schemes are more likely to be optimal when agents have privacy concerns compared with the case they don't

Other Results

- When **privacy** of agents should be protected, co-existence is more likely to be optimal
- When co-existence is optimal, cash inflation is strictly positive, although running negative inflation is feasible through OMO
- When CBDC is not a perfect substitute for cash, then
  - Co-existence is more likely to be optimal
  - CBDC, together with OMO, helps to achieve the first best even for the meetings in which only cash can be used

Fixed exchange rate ($\gamma_c = \gamma_e$) may be binding given sign restriction on CBDC transfers Main Results

Privacy

- Agents' types cannot be seen/used, so $t_e = t_e(z_e)$ not $t_e = t_e(z_e, w)$
- **Cash-only**: Welfare **unaffected** by private info.
- **CBDC-only:** Welfare is **lower** with private information, because IC_{12} and IC_{21} are present
- **Co-existence:** Welfare **unaffected** by private info.
  - Without privacy, high types may want to use cash, but low types don't want to use CBDC
  - With privacy, low types may want to use CBDC
    - **Shown** that is not binding, **because low types have to bring more money to mimic high types**
    - Not useful, as their marginal utility is less than high types

Privacy

- Co-existence is more likely to be optimal when agents have privacy concerns compared with the case they don't.