Digital Currencies and Bank Competition

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Introduction

- **Definition of banks: Institutions engaging both in credit and deposit-taking activities.**
  - Credit and liquidity risk management.
  - Bundling and cross-subsidies between credit and deposit activities
- **The role of banks is preponderant in payment systems today:**
  - In retail payment systems (distribution of cash, transfers of deposits)
  - In wholesale payment systems (access to Central Bank liquidity)
- **This role is increasingly challenged by the digitalisation of payments / entry of non-banks.**
- **In this paper: competition between banks and a private digital currency (DC) provider.**
- **Differentiation between banks and the DC provider along several dimensions:**
  - 1/ The business model of financial intermediation (deposits and payments only)
  - 2/ The characteristics of the payment instrument (PI) offered to consumers (differs from cash and the payment instrument offered by banks to transfer deposits)
  - 3/ The interest rate offered by the alternative deposit account

Research questions

- **How does competition impact the *use* of a digital currency as a means of payment?**

- **Methodology:** IO model of competition between banks and a DC provider

- **Main mechanism of the model:**
- **a)** consumers trade off between PIs (cash, transfer of bank deposits, transfer of deposits of digital currency) according to the value of the transaction, the foregone interest on deposits, the fee for payment transactions
- **b)** banks compete for deposits and consumers may always open a DC account
- **c)** banks fund illiquid loans with deposits and choose how much to hold in reserves by anticipating the consumers' payments needs
- **d)** when consumers pay from their bank account, banks may incur additional costs of liquidity
- **e)** the costs of liquidity are passed through to consumers (transaction fees, deposit fees, lending rates)
- **f)** when consumers pay from their DC account, banks save the additional costs of liquidity but lose the fees for payments

Results

- **1/ Determination of the market share of the digital currency in equilibrium according to:**
  - The design of the digital currency (interest rate, transaction fee, distribution mode)
  - Competition between banks (number of banks, cost of liquidity)
  - If there is a digital currency provider, consumers may use MORE their bank account to make payments because of competition (reduction in the transaction fee for transfers of bank deposits)
- **2/ Analysis of the impact of the digital currency on the equilibrium lending rate:**
  - If consumers use more their bank account to make payments, the lending rate increases in equilibrium.
  - **<u>Results driven by three assumptions:</u>**
    - 1/ Banks incur liquidity costs that depend on competition between payment instruments
    - 2/ Their cost of liquidity is not separable in the lending rate and the fee for transfers of bank deposits
    - 3/ The digital currency and the bank payment instrument compete both as a store of value and as a means of payment

The role of the regulatory framework

- **The regulatory framework is a key determinant of the adoption of the DC:**
- 1/ Who is allowed to distribute the digital currency?
  - -> In the paper: a different DC provider that does not offer lending
- 2/ Are non-banks allowed to open an account in the Central Bank?
  - -> In the paper: yes, with a specific DC- IOR (discussion if no)
- 3/ Does the DC rely on a different unit of account (token)?
  - -> In the paper: no
- 4/ Does the DC account bear interest?
  - -> In the paper: yes, possibly
- 5/ Is the fee for DC transactions regulated?
  - -> In the paper: yes, at marginal cost

Related literature:
Competition between payment instruments

- Literature on competition between currencies (Hayek, 1976)
- Competition for deposits and consumer demand for money (Towey, 1974, Saving, 1979, Santomero, 1979, Whitesell, 1989, 1992, Shy and Tarkka, 2002).
- Innovations in payments: DLT (Auer, Monnet, Shin, 2021), tokens (Prat et al., 2019, You and Rogoff, 2020), stablecoins…

- **<u>This paper:</u>**
  - 1/ Reduced competition of monetary instruments (Brunnermeier, James and Landau, 2019).
  - 2/ Model derived from Whitesell (1992)
  - 3/ No analysis of why the innovation brings value to users

Related Literature:
The role of financial intermediaries - narrow banks

- **The efficiency of bundling of sight deposits and lending:**
- Old debate (e.g., Chicago Plan, Knight et al., 1933, Friedman, 1960, Tobin, 1987).
  - Yes: Kashyap and Stein (2002): narrow banks break the complementarity of deposits and credit lines
  - No: Shy and Stenbacka (2000): narrow banks offer to consumers an additional investment opportunity with no risk.
- CBDCs and credit lines (Piazzesi and Schneider, 2020).
- **<u>This paper:</u>**
  - 1/ No discussion on the efficiency of the business model
  - 2/ Interested in the adoption of payment instruments

Related Literature:
Competition between FinTech and banks

- Literature on the disruption of financial intermediation:

  - Alternative payment providers and the disruption of banks' lending activity (Parlour et al., 2020).

  - Competition between banks and lending platforms (Biancini and Verdier, 2020).

  - Competition between big techs and banks.

- **This paper:**

  - 1/ the digital currency provider competes on the liability side of banks' balance sheet.

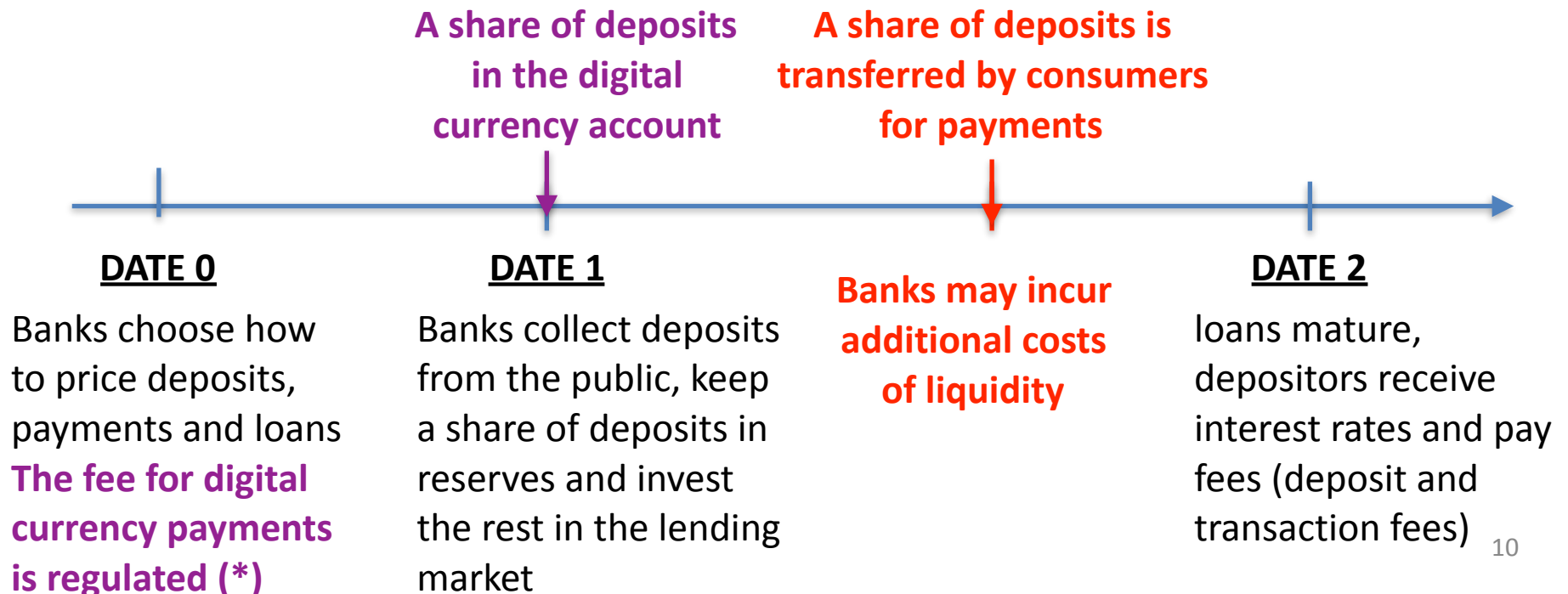 - 2/ there is a disruption of banks' management of liquidity.

Related Literature: Central Bank Digital Currencies

- CB as operators in Payment systems (Kahn et al. 2018) may impact:
  - bank lending (BIS, Mancini-Griffoni et al., 2019, Keister and Sanches, 2019, Chiu et al., 2019)
  - the transmission of the monetary policy (Goodfriend, 2016, Agarwal and Kimball, 2015, Rogoff, 2016)
  - financial stability (Fernandez-Villaverde et al., 2020)
  - sovereignty (Raskin, Saleh, Yermack, 2019)
- **This paper:**
  - 1/ industrial organization model of a digital currency
  - 2/ cost of liquidity for banks
  - 3/ transaction fees for payment instruments
  - 4/ no analysis of financial stability issues

The model

- Partial equilibrium IO model of competition
- Three dates and four types of risk-neutral agents: n banks, one digital currency provider, depositors and entrepreneurs.

A share of deposits in the digital currency account

A share of deposits is transferred by consumers for payments

DATE 0

Banks choose how to price deposits, payments and loans
The fee for digital currency payments is regulated (*)

DATE 1

Banks collect deposits from the public, keep a share of deposits in reserves and invest the rest in the lending market

Banks may incur additional costs of liquidity

DATE 2

loans mature, depositors receive interest rates and pay fees (deposit and transaction fees)
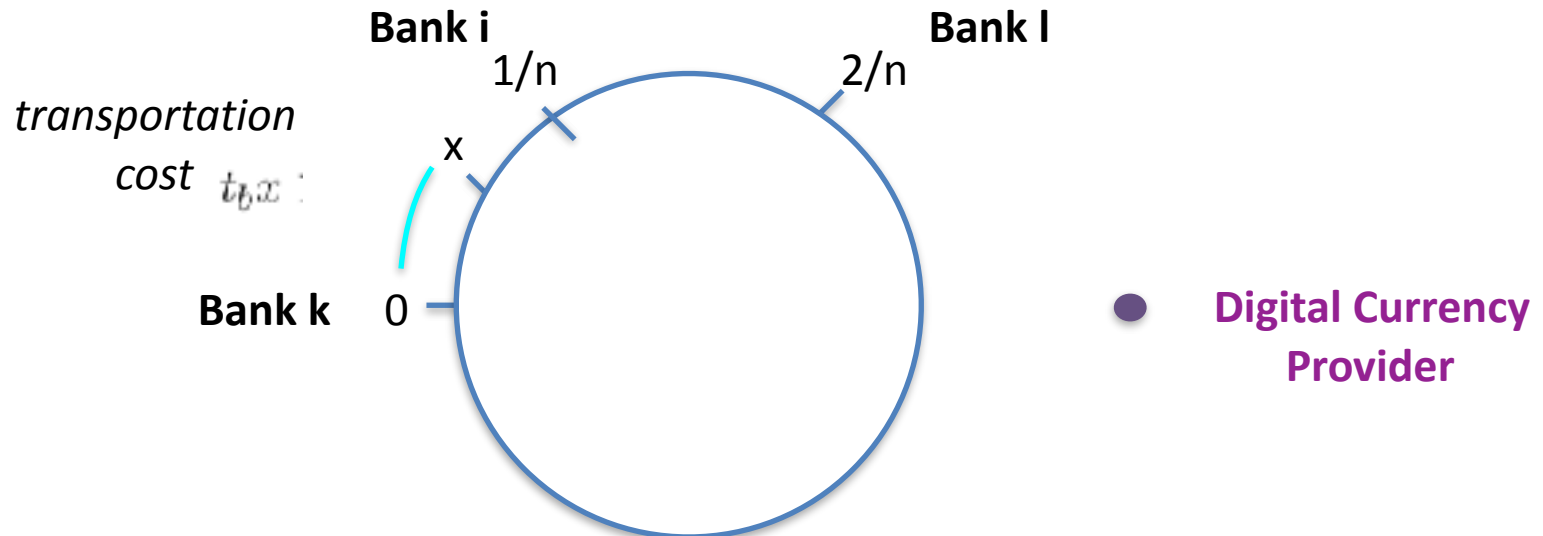
The model

- **The lending market:**
  - At date 1, banks make term loans, which mature and are paid off at date 2.

  - Linear demand for loans (Shubik and Levitan, 1980, Carletti, Hartmann and Spagnolo, 2007)

$$L_i = L - \gamma \left(r_i^L - \frac{1}{n} \sum_{k=1}^{n} r_k^L \right)$$

  - Borrowers are distinct from depositors
  - Constant aggregate demand for loans nL.
  - No credit risk.

The model

- **The deposit market - money storage and payment services:**
  - Choice between n differentiated banks (as in Salop, 1979)

Bank i — 1/n — Bank l — 2/n

transportation cost $t_b x$

x

Bank k — 0

● **Digital Currency Provider**

  - Deposit account in bank i: means to store a share α_i of deposits (d).
  - Exogenous in the baseline model, then discussion if endogenous.
  - Digital currency accounts: means to store a share $1 - \alpha_i$ of their deposits.
  - All depositors open a bank account and a digital currency account

The model

- **Competition between banks for deposits:**
  - Choice of the bank depends on
    - i) the linear transportation cost to open an account in a bank located at a distance x.
    - ii) the deposit fee F_i charged by each bank i
    - ii) the interest rates from deposits in a bank account and in a digital currency account
    - iv) the expected transaction costs incurred to make payments (by transfer of bank deposits or by dc)
  - The share of deposits obtained by bank i depends on competition $D_i(F_i, f_b^i, F_{-i}, f_b^{-i}, f_d)$

The model

- Comparison of both accounts for depositors

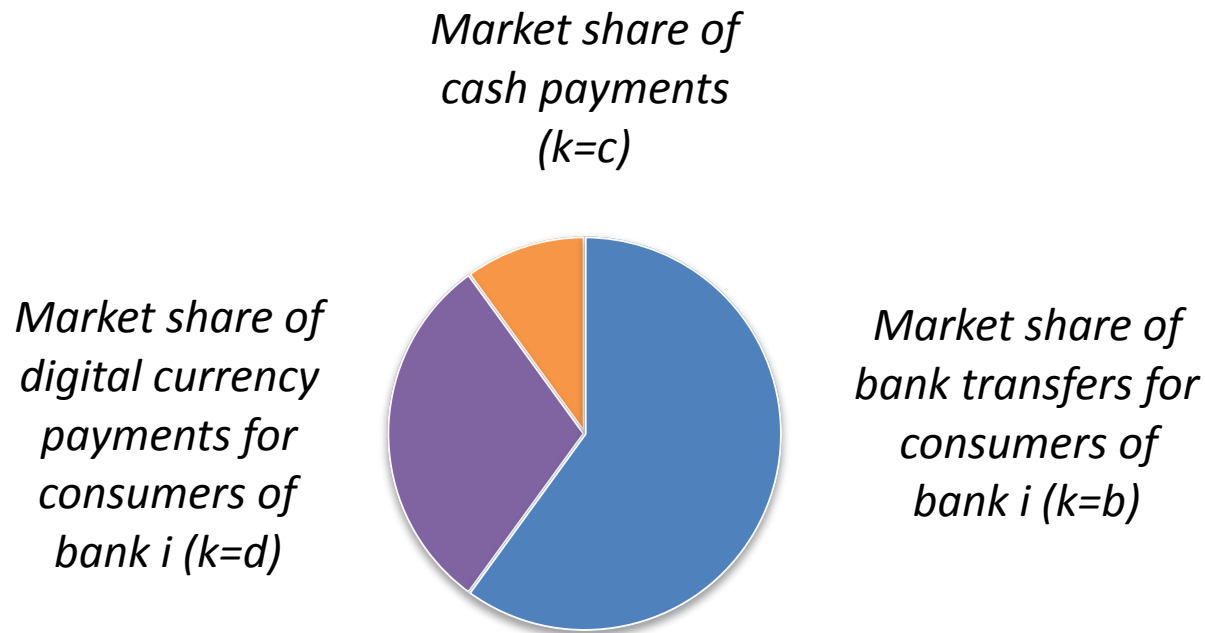|	BANK ACCOUNT (Bank i)	DIGITAL CURRENCY ACCOUNT
Utility	u_b	u_d
Cost of opening an account	• **Deposit Fee** F_i^1	**No cost**
Money storage	• **Interest rate** r_b	• **Interest rate** r_d
Payment Instrument	• **Bank transfer** f_b^i transaction fee: variable benefit: v_b	• **Digital currency** f_d transaction fee: variable benefit: v_d

The model

- **Payment decisions:**

  – Between date 1 and date 2, the consumers of bank i face a consumption shock expressed as a share of their deposits denoted s_i to make a transaction of size T_i , with $s_i d = T_i$.

  – Distribution of s_i common knowledge according to the probability density *h* with cumulative *H* (i.i.d)*.*

  – Transfers of deposits to another bank with probability φ

  – Trade off between paying from their bank account or their DC account according to the value of the transaction.

The model

- **Market shares of payment instruments:**
  - Market share for payment instrument $k \in \{c, b, d\}$ for consumers of bank i given by $\beta_k^i(f_b^i, f_d)$

Market share of cash payments (k=c)

Market share of digital currency payments for consumers of bank i (k=d)

Market share of bank transfers for consumers of bank i (k=b)

The model

- **Liquidity management and reserves:**
  - Each bank determines the quantity R_i of reserves to hold
  - The bank invests the rest in the lending market such that:

  $$L_i + R_i = (\alpha_i d) D_i.$$

  - The expected net benefit of liquidity management is

  $$\cdot EL_i(r_L^i, f_b^i, f_d)$$

  - Two cases depending on the transfer of bank deposits:
    - Lower transfer than the reserves, the bank receives the IOR τ
    - Higher transfer of deposits than the reserves, the bank incurs an additional cost of liquidity: $\rho.$

17

The model

- **Bank profits:**

  – The bank's profit is the sum of the profit on loans and deposits, and the expected net benefit of liquidity management:

  $$\pi_i(r_L^i, F_i, f_b^i) = (r_L^i - c_L)L_i(r_L^i, r_L^{-i}) + \mu_i(F_i, f_b^i, f_d)D_i(F_i, f_b^i, F_{-i}, f_b^{-i}, f_d) + EL_i(r_L^i, f_b^i, f_d)$$

  where the margin per depositor is given by:

  $$\mu_i(F_i, f_b^i, f_d) = F_i + (f_b^i - c_b)\beta_b^i(f_b^i, f_d) - IR_b^i(f_b^i, f_d).$$
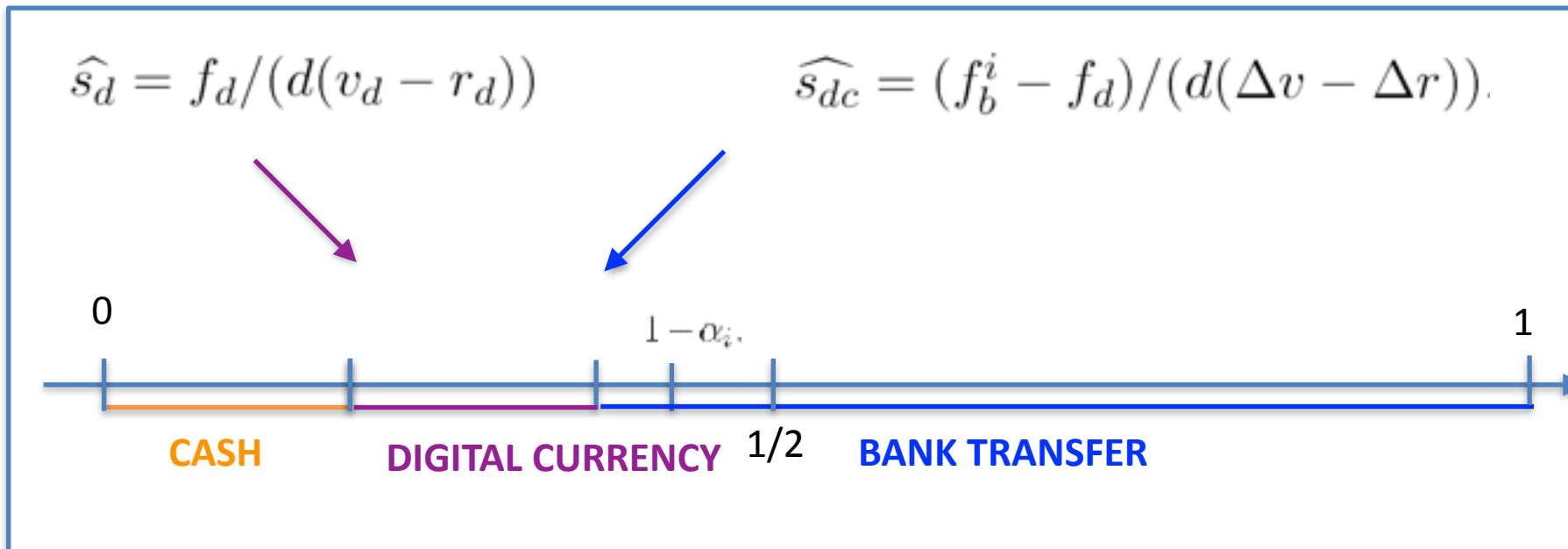
The model

- **The Digital Currency Provider:**
  - It is not allowed by regulation to lend to consumers.
  - It holds a 100% reserves ratio in a CB account remunerated at a rate τ_d => no need to incur additional cost of liquidity to settle payment transactions
  - The fee for DC payment is regulated: $f_d = c_d$
  - Its profit is the sum of DC storage revenues for all consumers of each bank i=1…n:

$$\pi_d = \sum_{i \in (1,n)} (\tau_d/r_d - 1) IR_d^i(f_b^i, f_d) D_i(F_i, f_b^i, F_{-i}, f_b^{-i}, f_d).$$

The choice of a payment instrument

- For intermediary values of the bank transfer fee, consumers trade off between paying by cash, by bank transfer and by digital currency.

$$\widehat{s_d} = f_d/(d(v_d - r_d)) \qquad \widehat{s_{dc}} = (f_b^i - f_d)/(d(\Delta v - \Delta r)).$$

0      $1 - \alpha_i.$ 1

CASH   **DIGITAL CURRENCY**   1/2   **BANK TRANSFER**

Competition between banks

- **The choice of a bank for depositors:**
  - Consumers decide in which bank to open an account.
  - Consumers take into account the expected surplus from deposits (interest rate revenues) and transaction costs.
  - The market share of bank i is given by:

$$D_i = \frac{1}{n} + \frac{CS_i}{t_b} - \frac{(CS_k + CS_l)}{2t_b}.$$

where the consumer surplus of opening an account in bank i is given by:

$$CS_i(F_i, f_b^i, f_d) = u_b + u_d + IR_b^i(f_b^i, f_d) + IR_d^i(f_b^i, f_d) - TC_i(f_b^i, f_d) - F_i.$$

The banks' best-responses to the choice of the fee for digital currency transactions

- Banks choose the price of loans, bank transfers and the deposit fee maximizing their profits. At the equilibrium, we have:

Share of deposits	$D^* = \alpha d / n,$
Reserves	$R^* = \alpha d / n - L$
Interest rate on loans	$r_L^* = \underline{r_L} - \left. \dfrac{\partial EL_i}{\partial L_i} \right|_{P^*}$
Bank transfer fee	$\dfrac{1}{n}(c_b - f_d - d r_d s_{dc}^*) h(s_{dc}^*) + \left. \dfrac{\partial EL_i}{\partial \widehat{s_{dc}}} \right|_{P^*} = 0.$

How does the digital currency impact banks' competition for deposits and loans?

- **A- Competition as a means to store value**
  - Crowding-out on deposits => lower amount of reserves
- **B- Competition as a means of payment**
- When consumers pay more often from their digital currency account:
  - 1/ Banks do not incur the marginal cost of bank transfers
  - 2/ The surplus that banks extract from depositors varies as:
    - consumers receive lower interest rate revenues from their digital currency accounts
    - consumers pay the transaction fee for digital currency payments
  - 3/ The consumers' payment choices impact banks' marginal cost of liquidity, and therefore, the interest rate on loans.

The banks' best-response with a low amount of reserves

- **If equilibrium with the use of the three payment instruments**
- If the fee for digital currency payments is neither too high nor too low, consumers pay by bank transfer if they need to transfer a share of deposits higher than:

$$s_{dc}^* = \frac{f_d - c_b + (\rho - \tau)n\varphi R^*}{d(\rho\varphi - r_d)}.$$

- The interest rate on loans is given by:

$$r_L^* = \underline{r_L} + \varphi(\rho - (\rho - \tau)H(s_{dc}^*)) + (1 - \varphi)\tau,$$

The impact of the digital currency on competition between banks

- **The impact of the digital currency on the use of bank deposits for payments (benchmark: trade-off cash/bank transfer):**
  - If $0 < r_d \leq \varphi \rho,$ the presence of the digital currency reduces the use of bank deposits for payments if:

$$c_b r_d \leq \varphi(c_d \rho + (\rho - \tau)(r_d(d - Ln) - (1 - \alpha)\rho \varphi d).$$

- **The impact of the digital currency on the interest rate on loans:**
  - If consumers make a lower use of their bank account for payments following the introduction of the digital currency, the interest rate on loans is reduced, whereas the reverse is true otherwise.

The adoption of the digital currency

- The market share of the digital currency as a payment instrument depends on:

  - The spread between the return on deposits in digital currency accounts and banks' expected marginal cost of liquidity

  - The spread between banks' marginal cost and marginal benefit of liquidity

  - The number of banks competing for deposits

- There may be also equilibria in which the digital currency is not adopted for payments and only as a store of value.

  - The digital currency still impacts the choice of the bank transfer fee (through banks' marginal cost of liquidity)

Extensions/ discussion

- **a- <u>Imperfect acceptance by merchants of the DC</u>**
  - Modification of the threshold value of the shock such that consumers pay from their bank account to consider the share of merchants who accept the digital currency.
  - Possible extension: the receiver pays for payments (IF?)
- **b- <u>The costs of holding cash</u>**
  - Higher costs of holding cash (resp., lower) would increase (resp., decrease) the market share of the digital currency.
  - Risks of theft, losses, and benefits of privacy.
- **c- <u>Safety considerations and financial stability</u>**
  - The balance kept by depositors on their bank accounts could reflect the agency costs of monitoring the bank's behaviour (and would increase in crisis times).

Extensions/ discussion

- **d- <u>The distribution mode of the digital currency</u>**

  - By banks or by alternative providers?

  - With access to Central Bank reserves?

  - With different reserve requirements for digital currencies?

  - Extension of the model with banks as distributors of the digital currency.

  - I assume that banks are constrained to hold a one to one ratio on overnight deposits in digital currency and that they cannot choose the fee for the digital currency.

  - Two types of accounts in banks.

  - => possible to study how the distribution mode impacts the adoption of the digital currency

Other factors impacting the adoption of the digital currency

- **e- <u>Complete bypass of banks:</u>**
  - Different proportion of unbanked consumers in developed countries and developing countries.
  - Either complete bypass of banks possible or either complete bypass of the digital currency provider.
  - I determine how this changes the results of the paper.
- **f- <u>Depositors as borrowers:</u>**
  - Examine the case in which a fraction of depositors also borrows from their bank (issue of overdrafts?)

Conclusion

- **Role of the regulatory framework for the adoption of a DC**

- **Directions for future research:**
  - 1/ Understand welfare effects of digital currencies more carefully
  - 2/ Need for empirical research to measure the elasticity of substitution between payment instruments
  - 3/ Impact of technology (e.g., blockchain versus other registers) on the costs of liquidity for participants to retail payment systems