

The Coming Battle of Digital Currencies

Will Cong

Cornell University

Simon Mayer

University of Chicago Booth

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New Era of Digital Payments and Currencies

- ▶ Rise of private payment systems: e.g., PayPal, Alipay, M-Pesa
- ▶ Cryptocurrencies and Decentralized Finance (DeFi) cause disruption
 - ▶ Cryptocurrency market cap has surpassed 3T\$ in November 2021
 - ▶ Stablecoins are private money and have market cap of 180B\$

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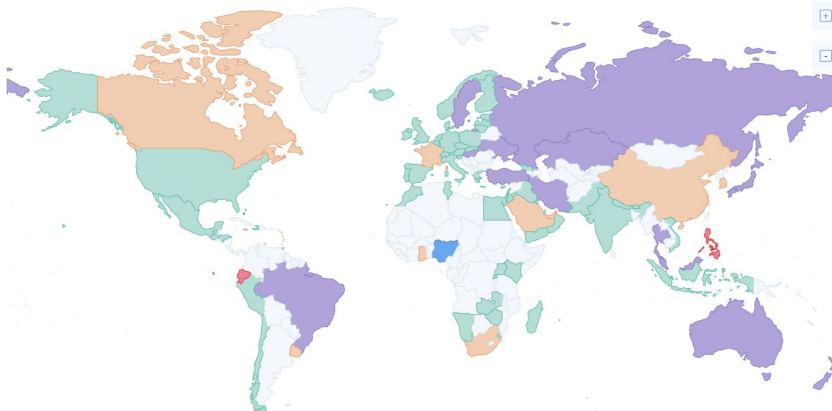
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- ▶ Digital currencies have attracted interest from policymakers
 - ▶ March 9th, 2022: President Biden signs Executive Order on Ensuring Responsible Development of Digital Assets
- ▶ Growing number of central banks (≈ 100) actively research Central Bank Digital Currencies (CBDC)

CBDC Initiatives around the World (CBDCTracker.org)

Today's Central Bank Digital Currencies Status

Database update: April 2022 • News update: Apr, 17 22

Cancelled Research Proof of concept Pilot Launched Show all



Example of CBDC: China's e-CNY



- ▶ Public debates: Concern that e-CNY challenges USD dominance
 - ▶ [Ehrlich \(2020, Forbes\)](#): “Not a cold war: China is using a digital currency insurgency to unseat the US dollar”

Private Digital Currency Competition: Facebook's Libra



- ▶ 2019: Facebook started digital currency initiative Libra
- ▶ Libra was never realized (at least in original form)

This Paper — A Battle of (Digital) Currencies

- ▶ How does **The Coming Battle of Digital Currencies** shape the future of money and currency competition?
- ▶ Should countries implement CBDC and, if so, which countries and why? What are the relevant trade-offs?
- ▶ What is the role of cryptocurrencies, stablecoins, and private payment systems in these developments?

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This Paper:

- ▶ Rationalize recent events in digital currency development
- ▶ Game-theoretic analysis of countries' strategies of digitizing money

This Paper — Model Overview

- ▶ Dynamic model of currency competition:
 - ▶ Two countries with currencies: A (“strong”) and B (“weak”)
 - ▶ One representative cryptocurrency C (also describes stablecoins)
- ▶ Currencies fulfill three functions of money:
 1. Store of value: Households store wealth
 2. Medium of exchange (liquidity services): Convenience yield
 3. Unit of account

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- ▶ Dynamic growth and adoption of cryptocurrencies
- ▶ Countries strategically react to competition from cryptocurrencies and other national currencies by launching CBDC

Main Results

- ▶ Feedback effects: Vicious circle of depreciation, and dollarization
 - ▶ Cryptocurrency “buffer zone” amidst battle of national currencies
- ▶ Rise of cryptocurrencies hurts strong currencies, but mitigates dollarization and so may benefit “weak” currencies

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- ▶ CBDC issuance pecking order:
 1. Non-dominant currencies (e.g., RMB): First mover advantage
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 3. Very weak currencies (e.g., El Salvador): Adopt crypto instead
- ⇒ Rise of cryptocurrencies produces/incentivizes financial innovation
- ⇒ Regulation of stablecoins: U.S. can capture seigniorage and “delegate” digital dollar development to private sector

Literature

- ▶ **Currency competition:** Lagos and Wright (2005), Farhi and Maggiori (2018), Fernandez-Villaverde and Sanches (2019), He, Krishnamurthy, and Milbradt (2016, 2019), Benigno, Schilling, and Uhlig (2022), among others ...
- ▶ **International Finance and Dominance of the Dollar:** Gopinath et al. (2020), Eren and Malamud (2021), Du, Pflueger, and Schreger (2020), Maggiori et al. (2020), Jiang, Krishnamurthy, and Jiang (2020, 2021), among others ...
- ▶ **Digital Currencies and CBDC:** Schilling and Uhlig (2018), Brunnermeier, James, and Landau (2019), Fernandez-Villaverde, Schilling, and Uhlig (2020), Piazzesi and Schneider (2020), Fernandez-Villaverde et al. (2021), Gorton and Zhang (2022), Gorton, Ross, and Ross (2022) among others ...

Dynamic Model

- ▶ Time runs discretely, $t = dt, 2dt, 3dt, \dots$ with time increments dt
- ▶ One representative OLG household endowed with one unit of perishable consumption good (=numeraire)
- ▶ Cohort t lives from t to $t + dt$ without time discounting:
 - ▶ Utility from consumption only at $t + dt$
 - ▶ Money serves as a store of value

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- ▶ Three currencies in fixed unit supply with endogenous value in consumption goods P_t^x for $x = A, B, C$:
 - ▶ Currency A (“strong” or “dominant”): e.g., USD
 - ▶ Currency B (“weak” or “non-dominant”): e.g., RMB
 - ▶ Representative (private) cryptocurrency C : includes stablecoins

Currency Convenience Yield

- ▶ m_t^x : Cohort t 's holdings of currency x in consumption good
 - ▶ Money as store of value: $m_t^A + m_t^B + m_t^C = 1$
- ▶ Convenience yield $Z_t^x v(m_t^x) dt$ from holding currency $x = A, B$ and convenience yield $Y_t v(m_t^C) dt$ from holding C

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- ▶ Equilibrium consumption: $c_{t+dt} = 1 - \tau_t^A dt - \tau_t^B dt$
 - ▶ τ_t^x : "Inflation tax" to holding national currency $x = A, B$
 - ▶ One could incorporate risk premia, interest rates, etc...

Household Optimization

- ▶ Household is price-taker and maximizes at each time t :

$$\max_{m_t^x \geq 0} \mathbb{E}_t \left[\underbrace{c_{t+dt}}_{\text{Consumption}} + \underbrace{(Z_t^A v(m_t^A) + Z_t^B v(m_t^B) + Y_t v(m_t^C))}_{\text{Convenience yield}} dt \right] \quad (1)$$

- ▶ Equilibrium condition (for $i = A, B$):

$$\underbrace{Y_t v'(m_t^C)}_{\text{Convenience}} + \underbrace{r_t^C}_{\text{Returns}} = \underbrace{Z_t^i v'(m_t^i)}_{\text{Convenience}} + \underbrace{r_t^i - \frac{\tau_t^i}{P_t^i}}_{\text{Net returns}}. \quad (2)$$

- ▶ Expected currency returns $r_t^i := \frac{\mathbb{E}[dP_t^i]}{P_t^i dt}$ (“appreciation”)

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 - ▶ Monetary neutrality: Currency appreciation $dP_t^x > 0$ could be transformed into interest payments to currency holders

Cryptocurrencies and Market Clearing

- ▶ m_t^C : Cryptocurrency adoption and demand
- ▶ Cryptocurrency adoption evolves according to:

$$\frac{dY_t}{Y_t} = m_t^C \cdot \mu dt \quad \text{for } \mu > 0. \quad (3)$$

- ▶ Dynamic feedback: $m_t^C \uparrow \implies Y_{t+dt} \uparrow \implies P_{t+dt}^C \uparrow \implies m_t^C \uparrow \dots$

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- ▶ Dynamic feedback: $m_t^C \uparrow \implies Y_{t+dt} \uparrow \implies P_{t+dt}^C \uparrow \implies m_t^C \uparrow \dots$
- ▶ Fiat-backed cryptocurrency or stablecoins: $\theta \in [0, 1]$ of crypto value P_t^C backed by currency A (e.g., USD)
- ▶ Market clearing for currency x : $m_t^B = P_t^B$, $m_t^C = P_t^C$:

$$m_t^A = P_t^A - \theta P_t^C \quad (4)$$

CBDC and Currency Digitization

- ▶ Country $x \in \{A, B\}$ chooses effort/investment e_t^x to launch CBDC at endogenous time T^x , increasing **convenience** Z_t^x :

$$Z_t^x = \begin{cases} Z_L & \text{for } t < T^x \\ Z_H + \alpha Y_t & \text{for } t \geq T^x. \end{cases}$$

- ▶ Random time T^x arrives with intensity λe_t^x

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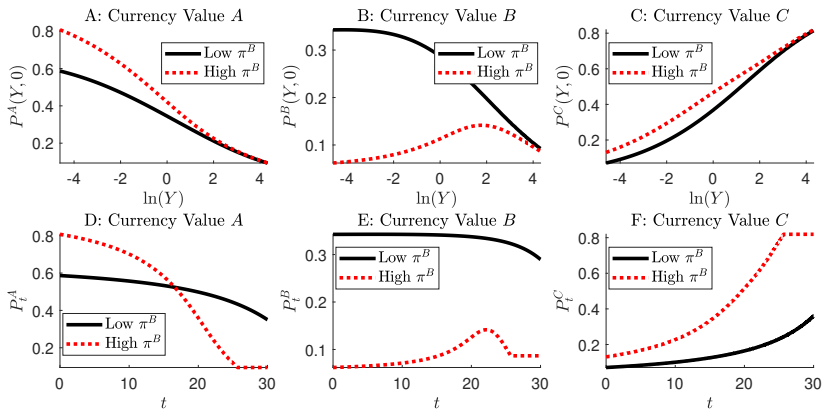
- ▶ Random time T^x arrives with intensity λe_t^x
- ▶ Government $x = A, B$ maximizes

$$V_t^x = \max_{(e_s^x)_{s \geq t}} \mathbb{E}_t^x \left[\int_t^\infty e^{-\delta(s-t)} \left(\delta g_s^x(m_s, P_s) - \frac{(e_s^x)^2}{2} \right) ds \right], \quad (5)$$

where we set $g_s^x(m_s, P_s) = \beta P_s^x$ for $\beta, \delta \geq 0$

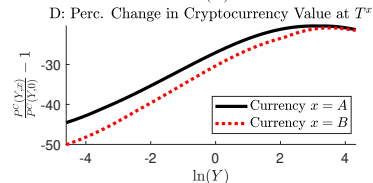
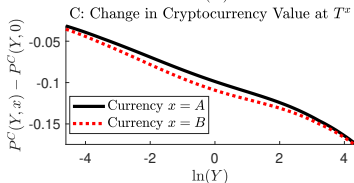
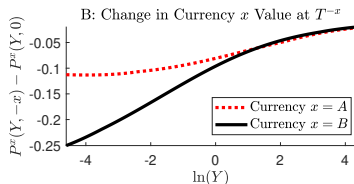
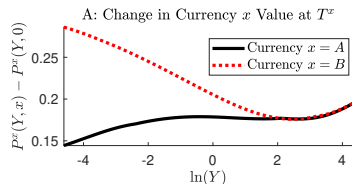
⇒ Government maximizes adoption, value, or strength of currency

Model Dynamics: Y increases over time



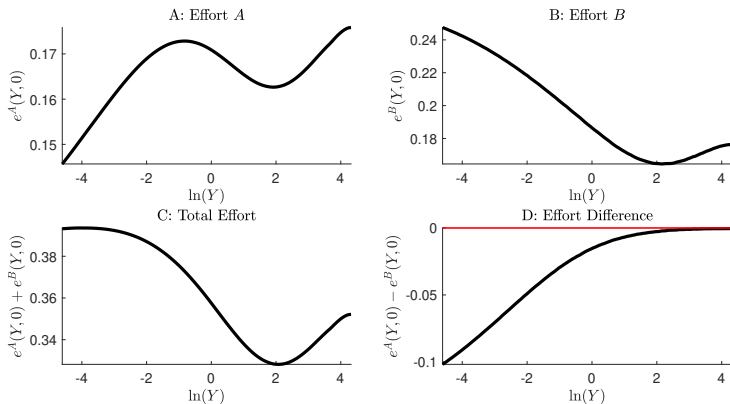
- ▶ Rise of cryptocurrency hurts the strong currency A , but may benefit the weak currency B
- ▶ Cryptocurrencies fill vacuum in currency space: Weakness of national currencies facilitates growth of crypto sector

Effects of CBDC issuance?



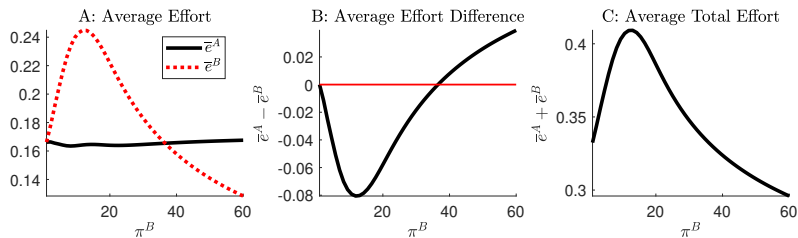
- ▶ CBDC issuance by countries with non-dominant (but relatively strong) currencies has largest effects
- ▶ Cryptocurrency kill zone: Launching CBDC early on nips cryptocurrency growth in the bud

CBDC Issuance and Digitization: Optimal Efforts



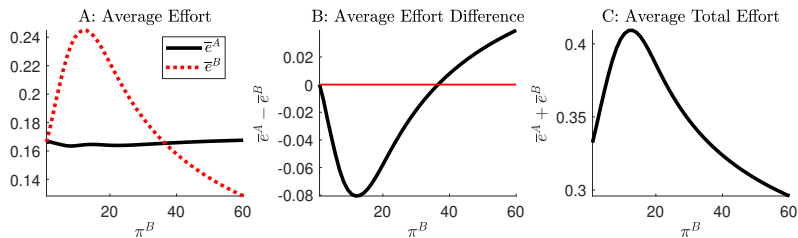
- ▶ $e^B > e^A$: Country *B* has higher incentives to issue CBDC
 - ▶ First-mover advantage
- ▶ Strong country *A*: Killer adoption (first peak) and unavoidable currency digitization (second “peak”)

CBDC Issuance and Digitization: A Pecking Order



- ▶ A country's incentives to develop CBDC follow an inverted U shape in the strength of its currency (relative to other currencies).

CBDC Issuance and Digitization: A Pecking Order



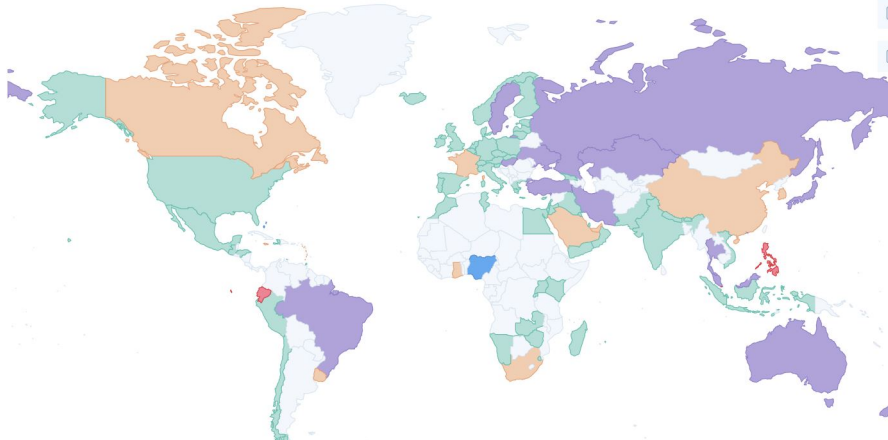
- ▶ A country's incentives to develop CBDC follow an inverted U shape in the strength of its currency (relative to other currencies).
- ▶ Pecking order: Non-dominant currencies (e.g., RMB) \Rightarrow Dominant currency (USD) \Rightarrow Very weak currencies

Pecking order consistent with current state of CBDCs

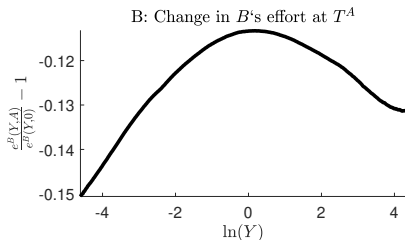
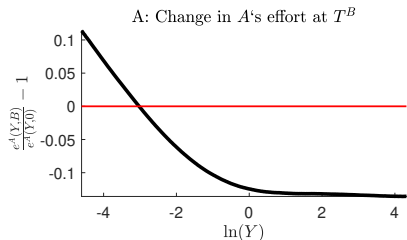
Today's Central Bank Digital Currencies Status

Database update: April 2022 • News update: Apr, 17 22

Cancelled Research Proof of concept Pilot Launched Show



Strategic Effects of CBDCs: Substitutes or Complements?



- ▶ CBDC issuance by strong country wipes out weaker country's incentives to gain first mover advantage
- ▶ CBDC issuance by weaker country challenge dominance of currency A and may strengthen stronger country's incentives

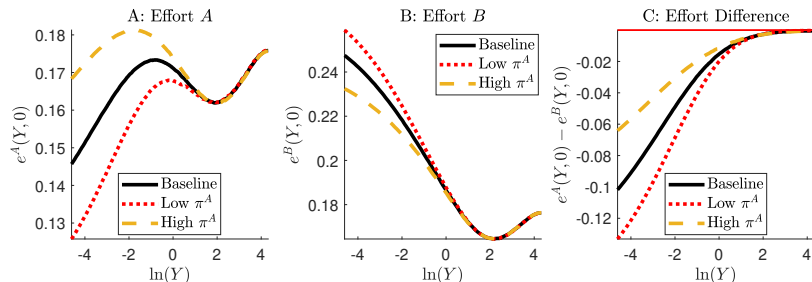
These trade-offs feature prominently in policy debates

- ▶ [Ehrlich \(2020, Forbes\)](#): “Not a cold war: China is using a digital currency insurgency to unseat the US dollar”
 - ▶ Call for action to actively research digital dollar
 - ▶ Concern that eCNY challenges USD dominance
- ▶ March 9th, 2022: [President Biden's Executive Order](#) also calls for active research on launching CBDC, i.e., digital dollar

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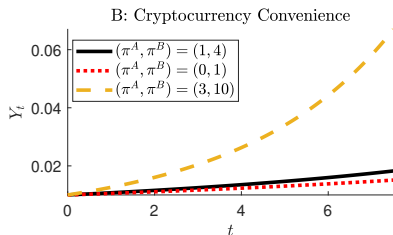
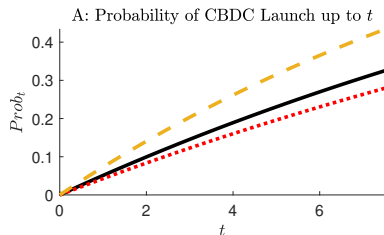
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- ▶ March 9th, 2022: [President Biden's Executive Order](#) also calls for active research on launching CBDC, i.e., digital dollar
- ▶ Duffie (2021): “Much has been written about the potential impact of eCNY, China's new CBDC, on the international dominance of the U.S. dollar. Concerns that the renminbi will rival the dollar in international markets are not warranted at this time, and these concerns are not a good reason to rush out a digital dollar before it is carefully designed.”

Currency dominance and CBDC



- ▶ $\pi^A \uparrow$: Currency A becomes “weaker”
- ▶ Currency A 's dominance lowers incentives to issue CBDC
 - ▶ Dollar dominance leads to inertia for innovating currency
 - ▶ Lack of competition undermines incentives to innovate currency

Currency Competition and Financial Innovation

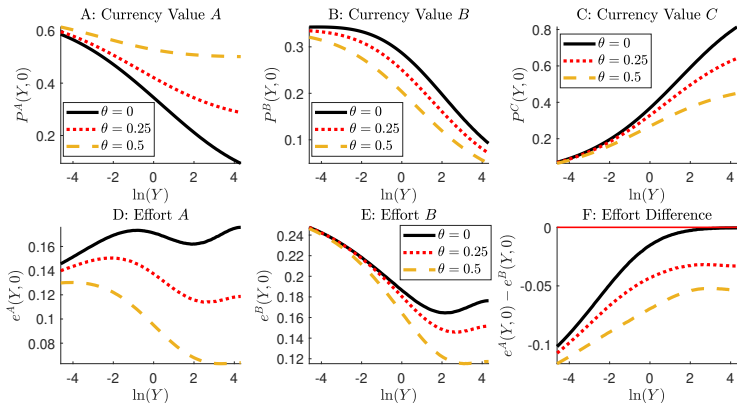


- ▶ $Prob_t$: Probability that CBDC is launched by time t
- ▶ The competition from cryptocurrencies stimulates (possibly valuable) financial innovation
- ▶ Countries react to growing competition by implementing CBDC competition
- ▶ Cryptocurrency (including stablecoins) as such can be seen as financial innovation

Fiat-backed cryptocurrency and stablecoins

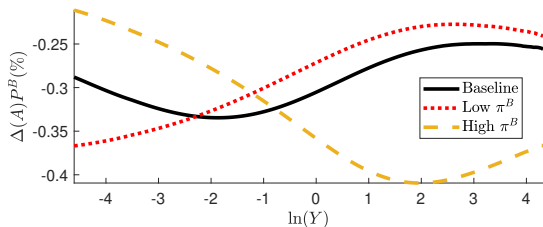
- ▶ Many stablecoins are pegged to U.S. dollar and partially backed by U.S. dollar reserves
 - ▶ Reserves may include cash or cash equivalents (T-bills)
 - ▶ Examples: USDC or BUSD
- ▶ Consider that fraction θ of cryptocurrency market cap P_t^C is backed by reserves consisting of currency A (i.e., U.S. dollars).

Fiat-backed cryptocurrency and stablecoins



- ▶ Stablecoins backed by currency *A* benefit *A* but harm *B*
- ▶ Requiring backing of stablecoins ($\theta \uparrow$) as alternative to developing CBDC: U.S. could “delegate” digital dollar development

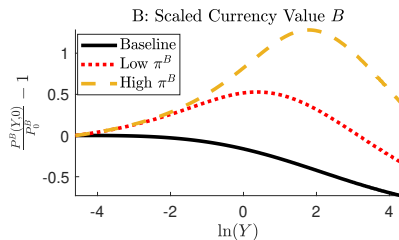
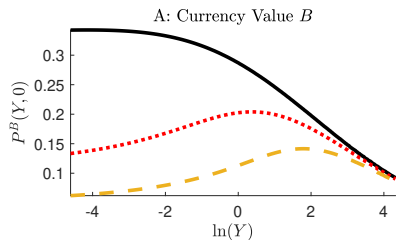
Emerging Economies and Digital Dollarization



⇒ Change in value of currency B when A (e.g., the US) launches CBDC

- ▶ In the long-run (for high $\ln(Y)$): Very weak currencies (dashed yellow line) suffer the most
- ▶ Emerging economies eventually suffer from digital dollarization (Brunnermeier, James, and Landau, 2019)

Which Countries benefit the most from the Rise of Crypto?



- ▶ The larger π^B , the “weaker” currency B
- ▶ Weaker currencies benefit relatively more from the rise of cryptocurrencies
 - ▶ Cryptocurrency mitigates competition from A
- ▶ Implication: Developing countries have incentives to “adopt” cryptocurrencies

Conclusions

- ▶ Dynamic model of currency competition between cryptocurrencies, fiat currencies, and CBDC
- ▶ CBDC issuance as countries' response to competition from cryptocurrency
- ▶ Novel pecking order of CBDC issuance: Strong but non-dominant currencies (e.g., RMB or Euro) \Rightarrow strongest currencies (USD) \Rightarrow weakest currencies
- ▶ Countries with weak currencies benefit from the rise of cryptocurrencies but eventually suffer from digital dollarization
- ▶ Digitization of money becomes unavoidable in the long-run and may eventually strengthen USD dominance