The Coming Battle of Digital Currencies

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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)
  - Stablecoins: Private money with market cap of 180B$

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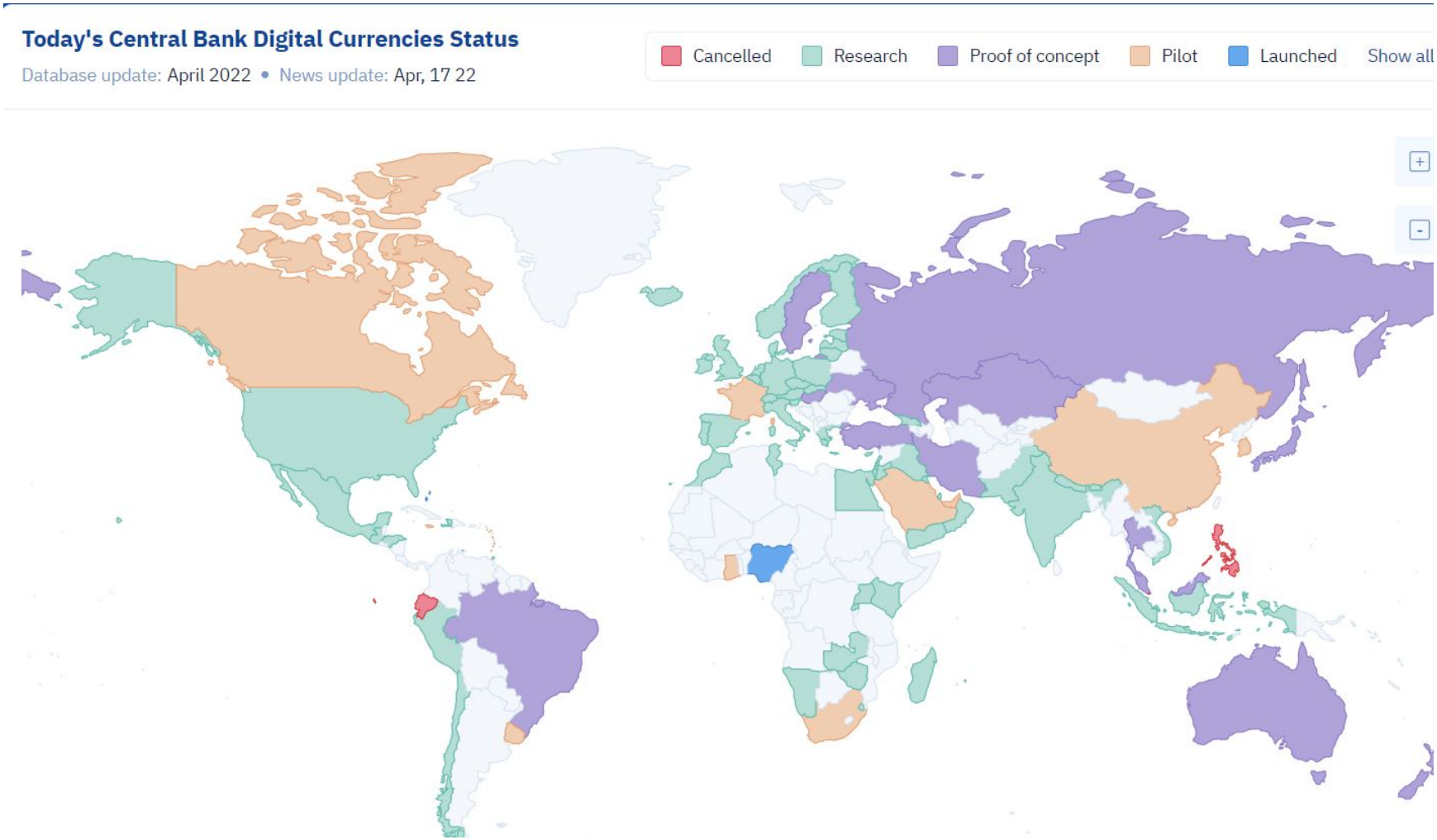
- Digital assets have attracted interest from policymakers
  - March 9th, 2022: Executive Order on Digital Assets
- Growing interest in Central Bank Digital Currencies (CBDC)

CBDC Initiatives around the World (CBDCTracker.org)



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"

Large Scale Digital Currency: 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:

- Currency competition with endogenous digitization
- 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
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- Dynamic growth and adoption of cryptocurrencies (private money)
- Countries strategically digitize currency (launch CBDC)

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- Feedback effects in currency competition and dollarization
  - Crypto as "buffer zone" mitigates (adverse) dollarization

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  - Crypto sector "creates" digital dollar

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), Auer et al. (2021), Gorton and Zhang (2022), Gorton, Ross, and Ross (2022) among others ...

Dynamic Model

- Time runs discretely, $t = dt, 2dt, 3dt, ...$ 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
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- Convenience yield from currency C: $Y_t v(m_t^C)dt$
- 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:

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

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

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

- Endogenous currency appreciation $r_t^i := \frac{\mathbb{E}[dP_t^i]}{P_t^i dt}$

Cryptocurrencies and Market Clearing

- Crypto demand/adoption m_t^C spurs future adoption:

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

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  - USD unit-of-account in crypto space

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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:

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

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

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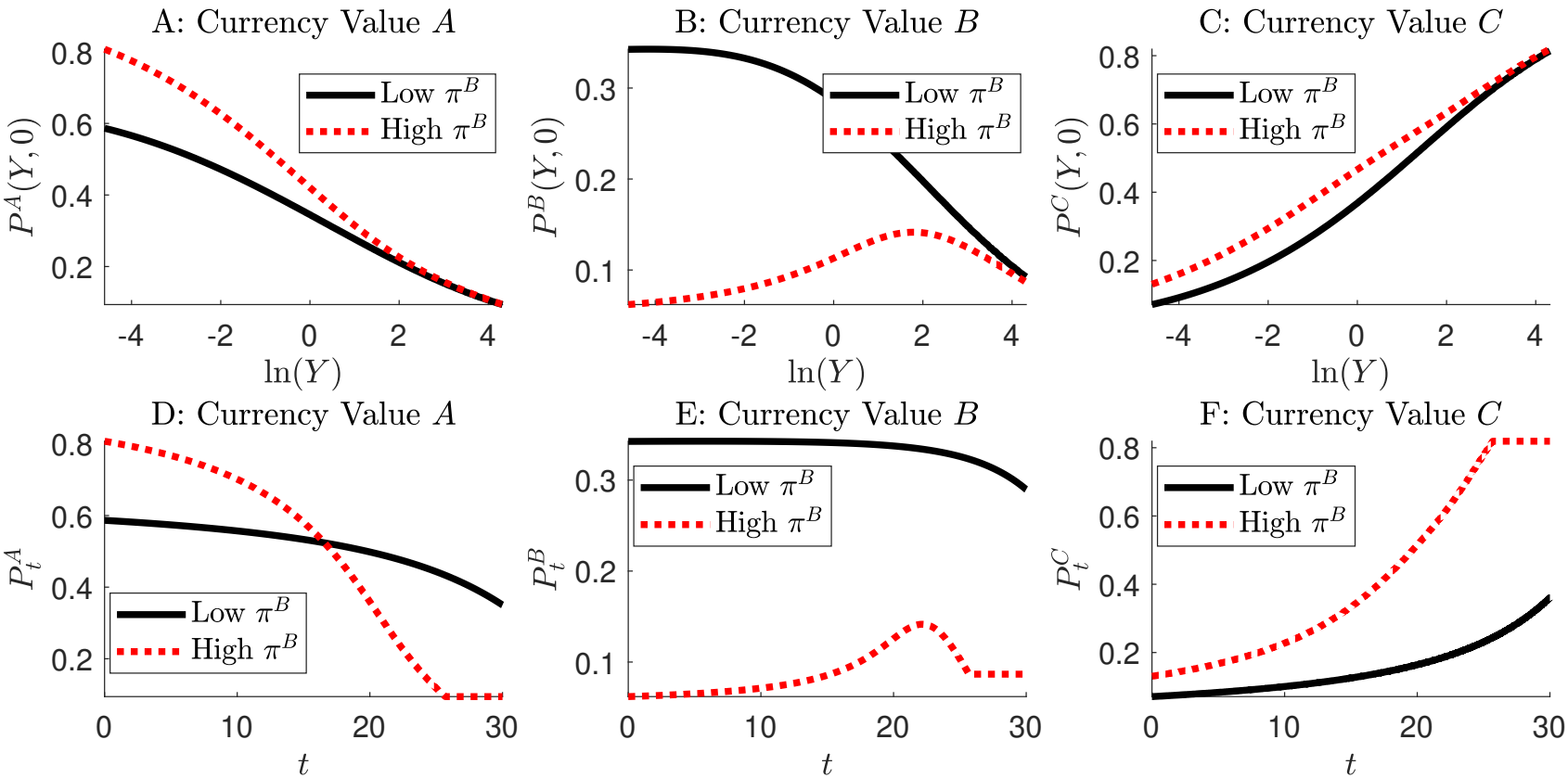
- Random time T^x arrives with intensity λe_t^x
- Government $x = A, B$ maximizes

$$V_t^x = \max_{(e_s^x)_{s \geq t}} \mathbb{E}_t^x \left[\int_t^\infty e^{-\delta(s-t)} \left(\delta g_s^x(m_s, P_s) - \frac{(e_s^x)^2}{2} \right) ds \right], \quad (1)$$

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

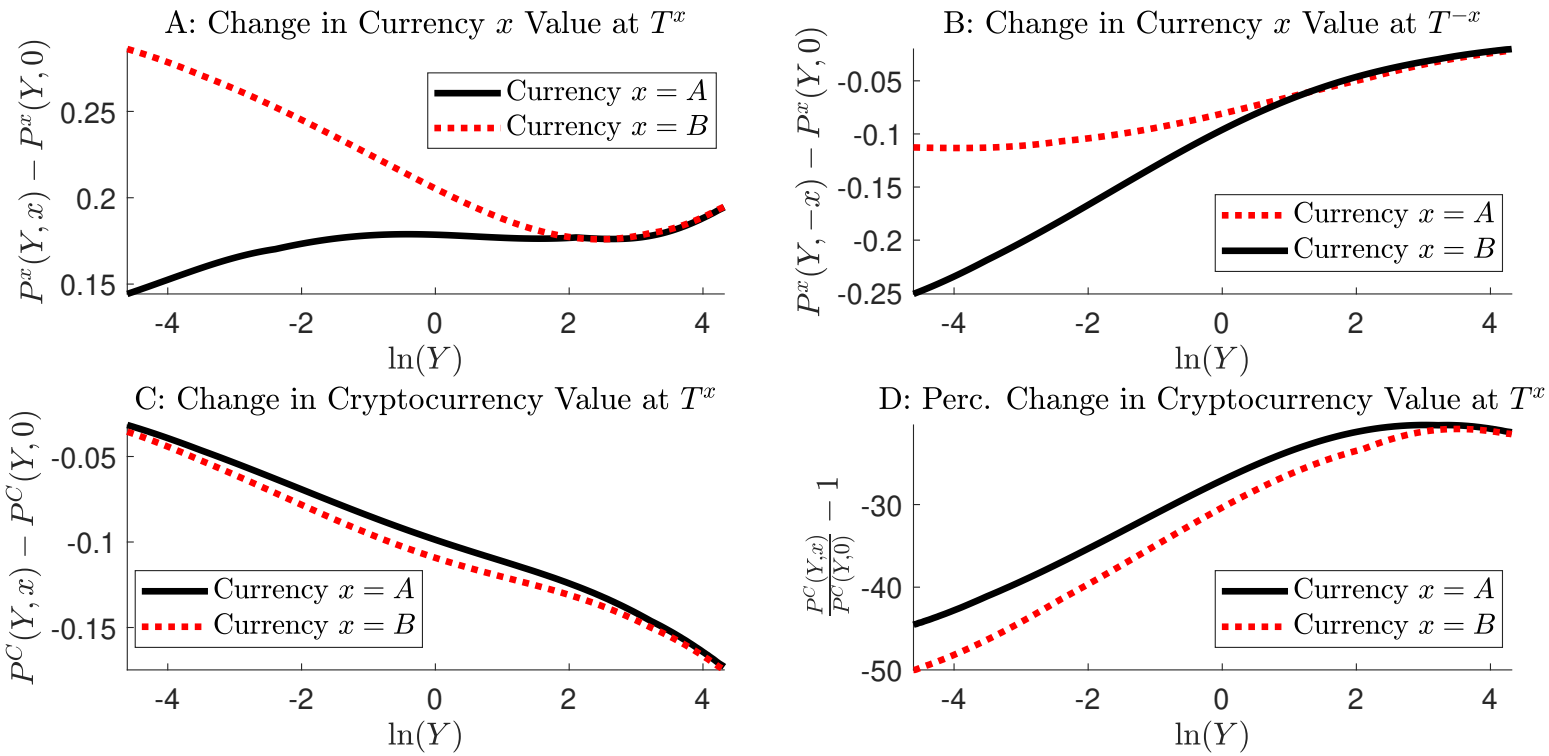
$\Longrightarrow$ Government maximizes adoption, value, or strength of currency

Model Dynamics: Y increases over time



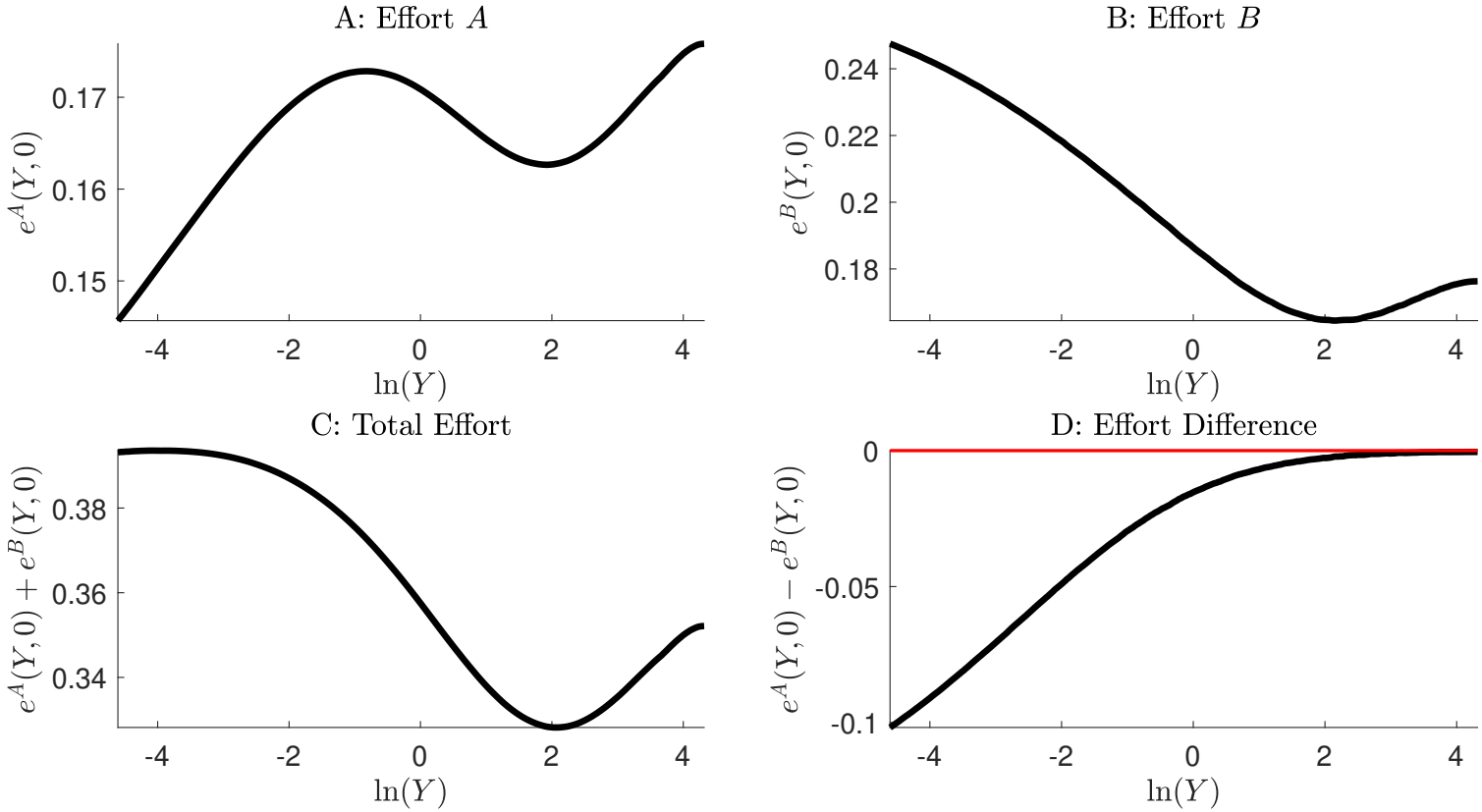
- Rise of cryptocurrency hurts A, but may benefit B
- Cryptocurrencies fill vacuum in currency space

Effects of CBDC issuance?



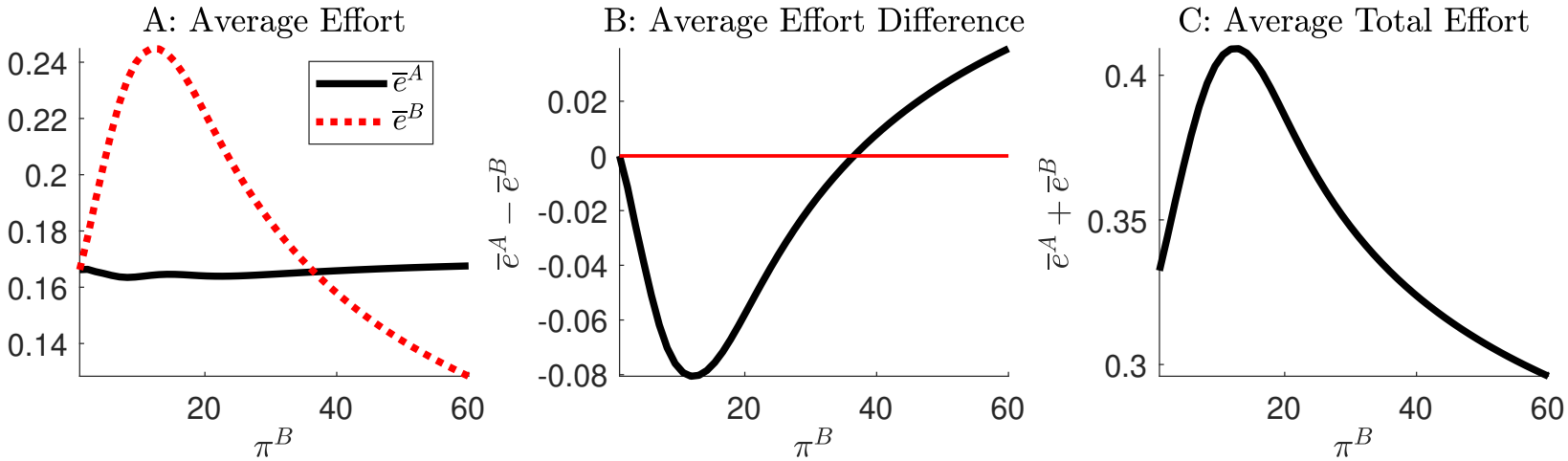
- CBDC issuance by countries with non-dominant (but relatively strong) currencies has largest effects
- Cryptocurrency kill zone: Launching CBDC early on nips cryptocurrency growth in the bud

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



- B's incentives e^B U-shaped in (relative) weakness of its currency π^B

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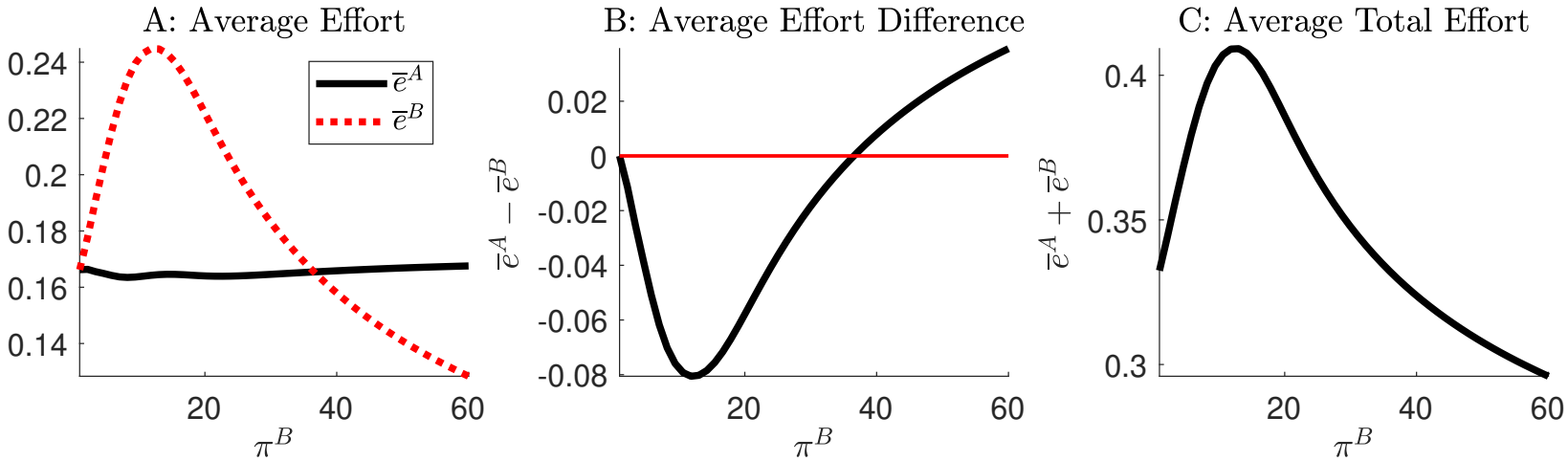
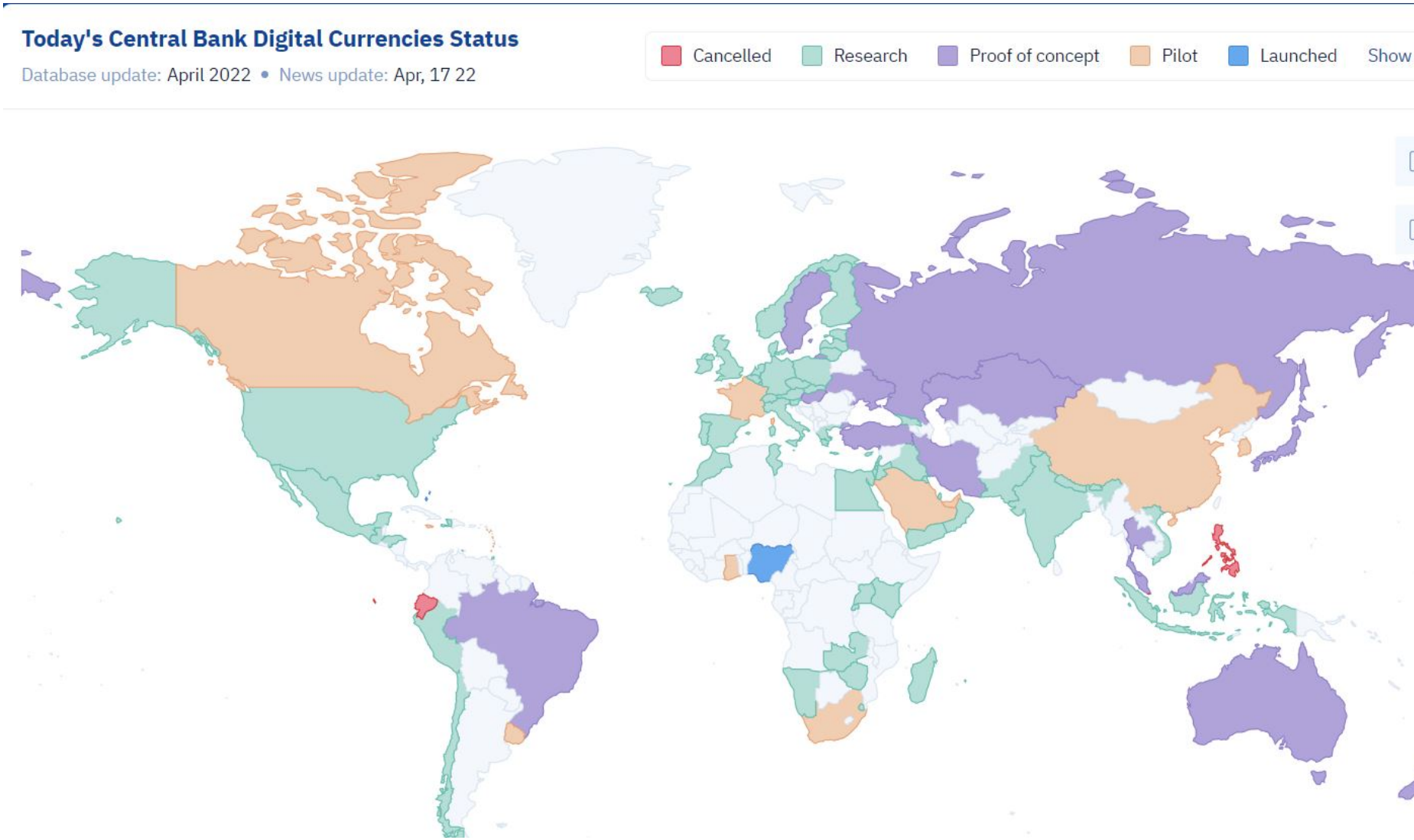
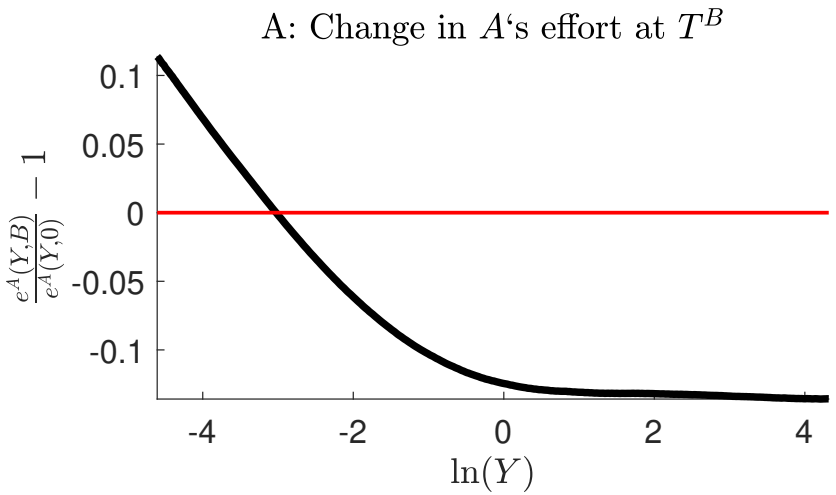


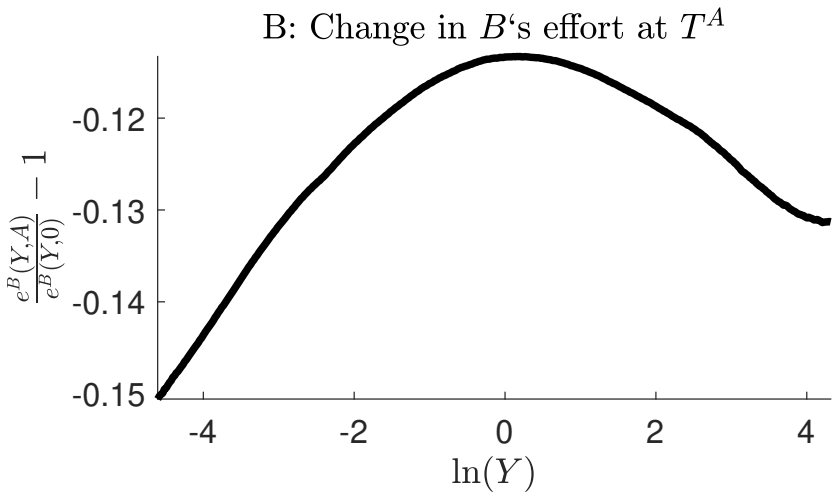
- B's incentives e^B U-shaped in (relative) weakness of its currency π^B
- Pecking order: Non-dominant currencies (e.g., RMB) $\Rightarrow$ Dominant currency (USD) $\Rightarrow$ Very weak currencies

Pecking order consistent with current state of CBDCs



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 challenges 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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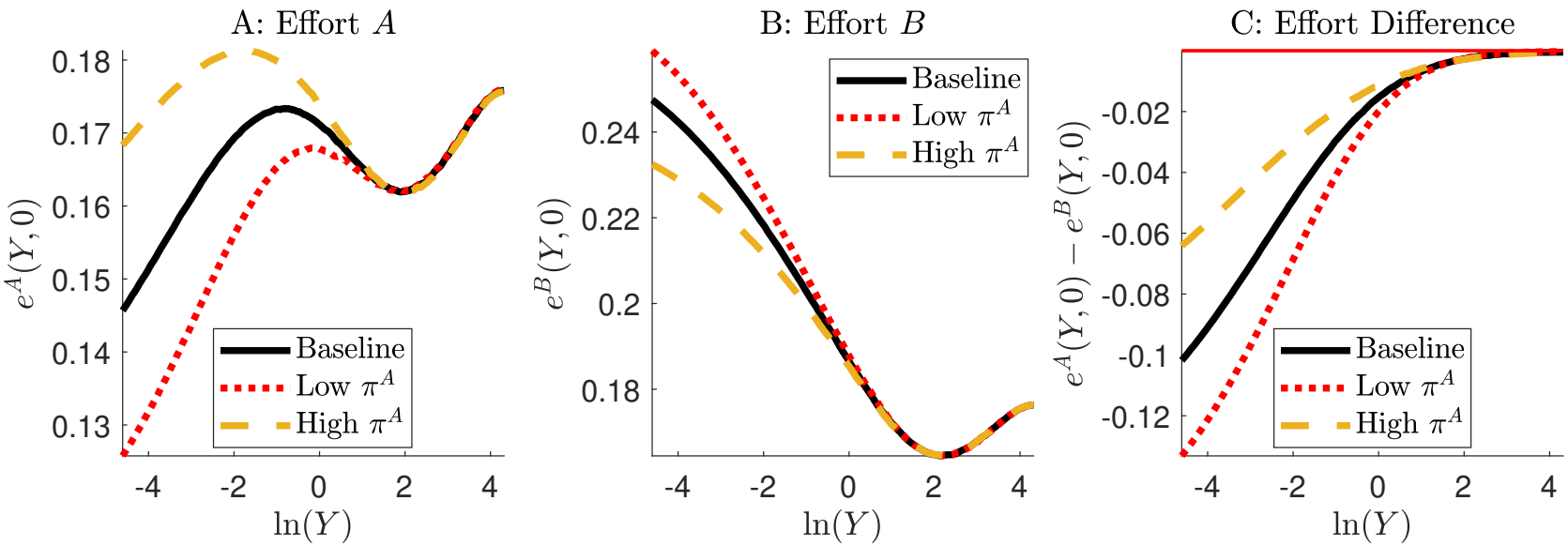
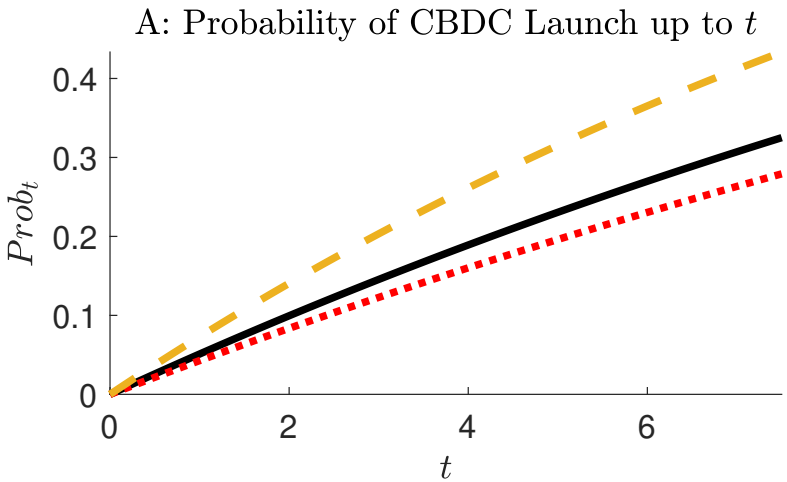
- Duffie (2021): "Much has been written about the potential impact of eCNY, China's new CBDC, on the international dominance of the U.S. dollar. Concerns that the renminbi will rival the dollar in international markets are not warranted at this time, and these concerns are not a good reason to rush out a digital dollar before it is carefully designed."

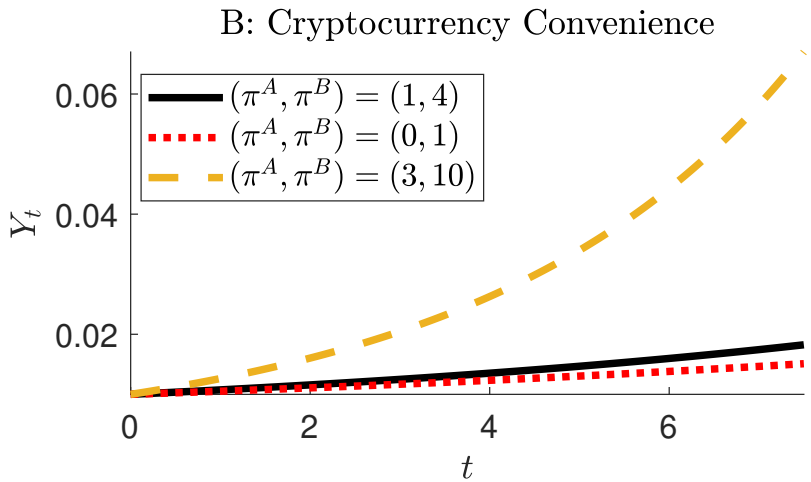
Currency dominance and CBDC



- $\pi^A \uparrow$: 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
- Competition from crypto stimulates (valuable) financial innovation
- Countries react to competition by implementing CBDC competition
- Cryptocurrency (stablecoins) can be seen as financial innovation

Fiat-backed cryptocurrency and stablecoins

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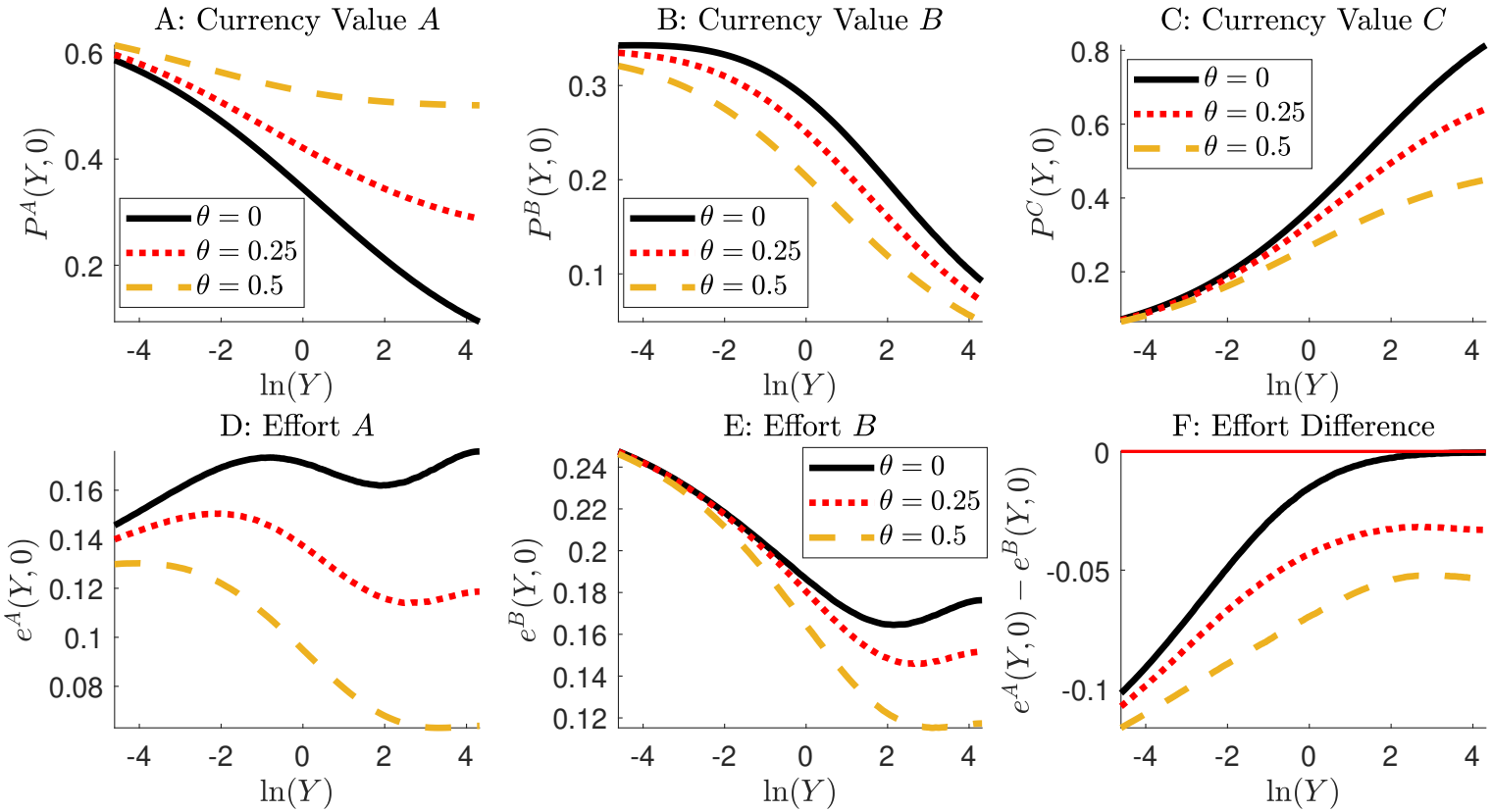
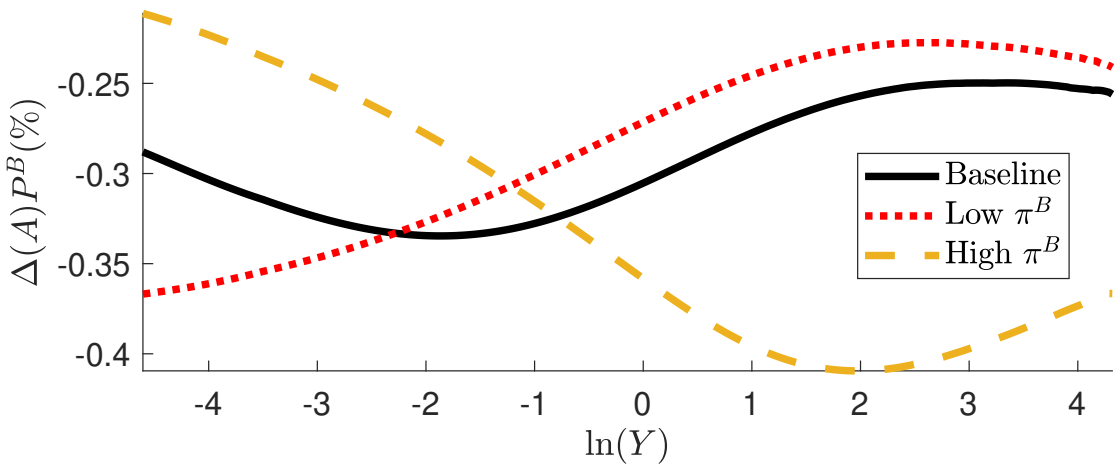


- Stablecoins backed by currency A benefit A but harm B
- Requiring backing of stablecoins ($\theta \uparrow$) as alternative to developing CBDC: U.S. could "delegate" digital dollar development
- $\theta > 0$ undermines A's incentives to digitize

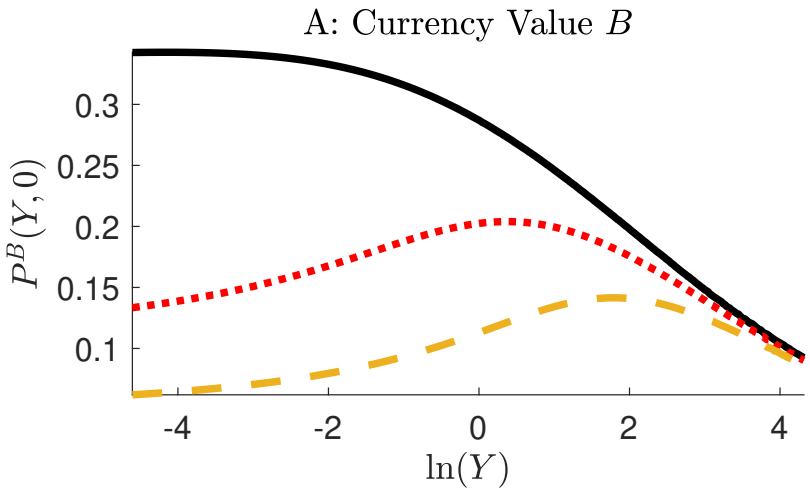
Emerging Economies and Digital Dollarization

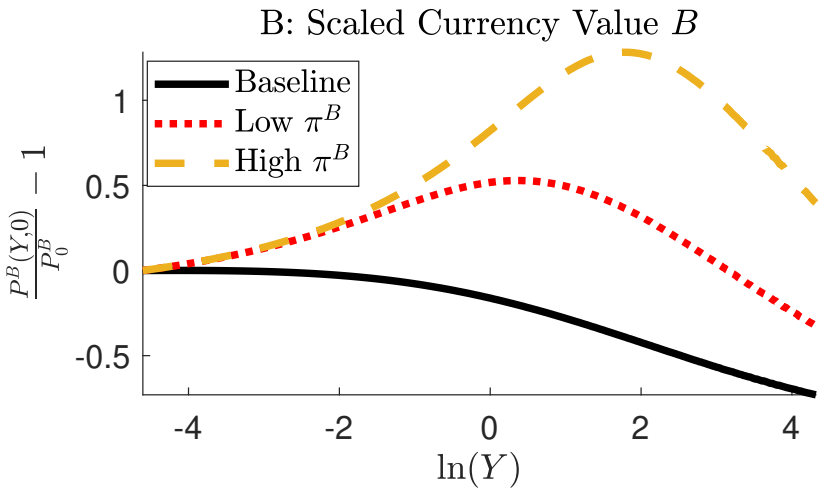


$\Longrightarrow$ Change in value of currency B when A (e.g., the US) launches CBDC

- 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 and digitization
- CBDC as response to competition from cryptocurrency
- CBDC pecking order: 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