

# Do Cryptocurrencies matter?

Stéphane Villeneuve (Toulouse School of Economics)

based on a research project with Bruno Biais (HEC) and Jean-Charles Rochet  
(TSE)

Webinar SCOR Foundation for Science

September 19th, 2024

# Cryptocurrency : A revolution that's a long way off ?

- When Bitcoin was introduced in 2009, a revolution in the way people could access and control their money was expected.
- After 15 years and regardless of scandals, we are not even close.
- What are the reasons why Bitcoin or any other cryptocurrency have not been widely adopted ?
- Bitcoin or any other cryptocurrency are not common forms of payments.
- **It is long** : 10 minutes on average to validate a transaction.  
<https://www.statista.com/statistics/793539/bitcoin-transaction-confirmation-time/>
- **It is expensive** : <https://www.statista.com/statistics/731459/bitcoin-transaction-fees/>

# How are cryptocurrencies different from the dollar and the euro ?

- Traditional currencies are backed by institutions, created by central and commercial banks.
- There is a legal obligation to accept them as a mean of payment which is not the case for private cryptocurrency.
- Cryptocurrency : created by internet network nodes, distributed  
⇒ Means of payment : *allows online payments to be sent directly from one party to another without going through a financial institution* (Nakamoto, 2008)
- El Salvador is the sole country to give a legal tender to Bitcoin.
- **Can it work ? Or, are cryptocurrencies just a bubble about to burst ?**

# A few warnings from enlightened people

Agustin Carstens, BIS, 15 November 2018

*For payments where buyer and seller never meet in person, trust is vital. Here, a decentralized network of anonymous computers cannot replace tried and tested institutions like central banks.*

Jean Tirole, FT, November 2017

*Bitcoin is a pure bubble, an asset without intrinsic value. Its price will fall to zero if trust vanishes.*

# Cryptocurrency vs hyperinflation

But,

- What happen if institutions become dysfunctional?  
*Turkey stands out with very high cryptocurrency ownership. . .16 to 25%, Ante, Fiedler, Steinmetz, 2023.*
- Hyperinflation (Venezuela, Turkey) & bank accounts frozen(Argentina, Lebanon) *Argentines' efforts to preserve their savings amid the ongoing decline of the Argentine peso has resulted in the nation hitting its highest demand for Bitcoin. Coin Telegraph, March 2023.*
- The value of crypto to people is not obvious but some event like hyperinflation encourage them to explore crypto.

# Why does hyperinflation begin ?

- *Hyperinflation* is when the prices of goods and services rise more than 50% per month. *Galloping* inflation, sends prices up 10% or more per year.
- Hyperinflation has two main causes : an increase in the money supply and demand-pull inflation.

Money is printed to unsustainable fiscal policy, Lopez, Mitchener (2020)

# Are private money a solution ?

- To keep from paying more for goods tomorrow, people begin hoarding or seeking *safe* asset.
- In *Denationalisation of Money (1976)*, Hayek advocates *the replacement of the government monopoly of money by competition in currency supplied by private issuers who, to preserve public confidence, will limit the quantity of their paper issued and thus maintain its value.*
- Can private money deliver Hayek's ambition ?
- Crypto can be viewed as an alternative to the existing financial system (*digital gold*), which means governments and banks are not incentivised to facilitate their adoption.
- More than 40 countries banned Bitcoin.

# Characteristics of cryptocurrency

- Decentralisation : it is not under the control of any government or central bank but is operated by a global community of miners and codes.
- Unlike governments that can print more money, coins cannot be created. Predetermined monetary policy (set by protocol).
- Preserve anonymity, transaction through a digital wallet. Difficult to tax
- But! Cryptocurrencies are in general highly volatile, and are subject to sudden, massive price swings. <https://decrypt.co/247751/most-ton-holders-in-the-red-as-price-keeps-falling-after-t>



# Model

- We propose a continuous-time model with a government and many agents operating iid risky technologies.
- Moral-hazard problem  $\rightarrow$  agents privately observe their output.
- Money used as safe asset to buffer agent's idiosyncratic productivity shock.
- Agent make portfolio choice : risky asset and money
- Government funds public spendings with taxes and seigneurage.

# Benchmark : economy without crypto

- Many agents with discount rate  $\rho$  and log utility.
- **One good** : can be consumed or invested in a constant return to scale technology with idiosyncratic production risk.
- Each agent hold risky capital  $k_t$  and public money  $m_t$ .
- Capital evolution :

$$dk_t = k_t(\mu dt + \sigma dB_t), (B_t)_t \text{Brownian motion}$$

- **Agent's wealth** :  $e_t = k_t + \frac{m_t}{p_t}$ , where  $p_t$  price of good in money at time  $t$ .
- Each agent chooses consumption and portfolio allocation to maximize

$$\mathbb{E} \left[ \int_0^{+\infty} e^{-\rho t} \log(c_t) \right].$$

# Government policy

- The government chooses its fiscal, budget and monetary policy
  - **Fiscal policy** : linear wealth tax rate  $\tau$ .
  - **Budget policy** : spendings= constant proportion of aggregate capital  
 $G_t = \gamma K_t$ .
  - **Monetary policy** : growth of money supply  $dM_t = M_t g_m dt$ ,
- Budget constraint : spendings=taxes+ seignorage

## Budget constraint

$$\gamma K_t = \tau K_t + g_m \frac{M_t}{p_t}.$$

# Optimal agent's choices

- Standard **Merton** problem : how much to consume, allocation between risky capital and money.
- Optimal policies
  - Optimal consumption=constant fraction  $\rho$  of wealth :  $c = \rho e$ .
  - Optimal capital=constant fraction  $x$  of wealth :  $k = xe$ .
- inflation rate  $\pi$ ,  $dp_t = p_t \pi dt$ , we have

$$x = \min\left(\frac{\mu + \pi}{\sigma^2}, 1\right).$$

- Optimal money holdings  $1 - x$  decreases with inflation but increases with risk  $\rightarrow$  money=safe asset.
- Money holding ( $x < 1$ ) implies  $\pi < \sigma^2 - \mu$  **limited inflation**.

# Monetary equilibrium

- When agents hold money :  $\pi = \sigma^2 x - \mu$
- inflation= growth of money- real growth

$$\pi = g_m - g$$

- real growth=productivity-spending rate-rate of consumption

$$g = \mu - \gamma - \frac{\rho}{x}$$

- Combining these equations, agent's holding of risky capital satisfies

$$g_m + \gamma = \sigma^2 x - \frac{\rho}{x}.$$

# Government policy

- By setting budget ( $\gamma$ ) and monetary ( $g_m$ ) or equivalently  $(x, \gamma)$ , government solves

$$\max_{x, \gamma} \beta U(x, \gamma) + (1 - \beta) \frac{1}{\rho} \left( \log(\gamma K_0) + \frac{\mu - \gamma - \frac{\rho}{x}}{\rho} \right).$$

- weight  $\beta$  on agent's utility, weight  $1 - \beta$  on government's utility from spendings.

# Government's optimal policy

- Government spendings :  $\gamma = \rho(1 - \beta)$
- Monetary policy to force agents to invest  $\min(x^*(\beta), 1)$  with

$$\frac{\sigma^2 x^*(\beta)^3}{\rho} + x^*(\beta) = \frac{1}{\beta}.$$

- $x^*(\beta)$  decreasing in  $\beta$   
 $\Rightarrow$  **benevolent** gov (high  $\beta$ ) : **low** inflation while **predatory** gov (low  $\beta$ ) : **high** inflation.
- If  $\beta$  very low : **no demand for money**.

# Introducing Crypto

- For simplicity constant supply : At time 0,  $\hat{M}_0$  tokens issued.
- Agents hold capital  $k_t$ , public currency  $m_t$  and crypto  $\hat{m}_t$ .
- price of good in token  $\hat{p}_t$ .
- Agent's wealth

$$e_t = k_t + \frac{m_t}{p_t} + \frac{\hat{m}_t}{\hat{p}_t} = e_t(x + b + \hat{b}).$$



# Bubble can crash

- At first time of a Poisson process with intensity  $\lambda$ , tokens worthless.
- Either due to self-fulfilling belief or technological problem (Garratt Wallace (2018), Biais et al. (2023))
- Public currency price jumps to  $p_t^+$ .

- Crypto constrains monetary policy : gov set inflation s.t.

$$x \leq x_c = \frac{\sqrt{\rho + \lambda}}{\sigma}$$

- Otherwise agents do not hold public currency (hyperinflation).
- Large likelihood of bubble crash  $\Rightarrow$  large  $x_c$ , crypto have no effect on monetary policy.

# Impact of Crypto on monetary policy

- Benevolent gov does not want to set inflation too high,  $x^*(\beta) \leq x_c$ . Agents hold capital and public currency only.
- Predatory gov would like high inflation.  
→ Agents hold capital with  $x_c$ , public currency and crypto if  $\lambda$  not too large.

# Conclusion

- Money=safe asset to buffer productivity shocks
- Without Crypto : non benevolent governments use monetary policy to extract rents from agent leading to hyperinflation.
- When cryptocurrency competes with public money ; government cannot set inflation too high, otherwise agents abandon public money for crypto.
  - If gov benevolent, crypto is useless (gov do not want ton inflate anyhow)
  - If gov predatory, competition with *sustainable* crypto forces government to lower inflation