Discussion of "More on Money Mining and Price Dynamics: Competing and Divisible Currencies", by Michael Choi and Guillaume Rocheteau

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Introduction

- Choi and Rocheteau (AEJ Macro, 2020) (CR) study the price dynamics of monies privately mined with a time-consuming technology.
- They consider an environment based on Trejos and Wright (1995), with indivisible money.
- This paper extends their analysis by introducing divisible money and currency competition.

Fiat Money

- As in CR, there exists a unique equilibrium where both the value and the quantity of money increase over time and converge to a steady state.
- There also exist a continuum of perfect-foresight equilibria where the quantity and the value of money first increase over time and then the value of money decreases while the quantity remains constant.
- Self-fulfilling equilibria with a constant quantity of money and a decreasing value of money are common in monetary models.
- Now, equilibria where both the value and the quantity of money increase over time are not common.

Fiat Money

$$\rho = \frac{\dot{\phi}_t}{\phi_t} + \alpha \underbrace{(1 - m_t)}_{\text{miners cannot produce}} \theta \frac{u'(q_t) - 1}{(1-\theta)u'(q_t) + \theta}$$

$$\frac{\dot{A}_t}{A_t} = \overbrace{\lambda m_t}^{\text{endogenous money creation}} \underbrace{\left(\frac{\overline{A} - A_t}{A_t}\right)}_{\text{mining rate decreases in the stock of money}}$$

where

$$m_t = \begin{cases} 1 & \text{if } \lambda\left(\overline{A} - A_t\right)\phi_t > (1-\theta)\left[u(q_t) - q_t\right] \\ [0,1] & \text{if } \lambda\left(\overline{A} - A_t\right)\phi_t = (1-\theta)\left[u(q_t) - q_t\right] \\ 0 & \text{if } \lambda\left(\overline{A} - A_t\right)\phi_t < (1-\theta)\left[u(q_t) - q_t\right] \end{cases}$$

and

$$(1-\theta)u(q_t) + \theta q_t = \phi_t A_t$$

Fiat Money - Boom Phase

- In the boom phase, all producers mine. This implies

$$\frac{\dot{\phi}_t}{\phi_t} = \rho$$

  and the value of money increases over time.

- Since all producers are mining, there is no trade during the boom phase. Intuitively, the fact that there is no liquidity value makes it necessary for the fundamental value of money to increase.

- To shed more light on the trade-off between the fundamental and the liquidity value of money, consider a simple variation of their set up.

- We assume that not all producers have the skills to be miners, and that skills arrive at a rate δ.

Fiat Money - Introducing Mining Skills

$$\rho = \frac{\dot{\phi}_t}{\phi_t} + \alpha(1 - m_t)\theta \frac{u'(q_t) - 1}{(1-\theta)u'(q_t) + \theta}$$

$$\frac{\dot{A}_t}{A_t} = \lambda m_t \left(\frac{\overline{A} - A_t}{A_t} \right)$$

where

$$m_t = \begin{cases} 1 - e^{-\delta t} & \text{if } \lambda \left(\overline{A} - A_t \right) \phi_t > (1-\theta) \left[u(q_t) - q_t \right] \\ \left[0, 1 - e^{-\delta t} \right] & \text{if } \lambda \left(\overline{A} - A_t \right) \phi_t = (1-\theta) \left[u(q_t) - q_t \right] \\ 0 & \text{if } \lambda \left(\overline{A} - A_t \right) \phi_t < (1-\theta) \left[u(q_t) - q_t \right] \end{cases}$$

and

$$(1-\theta)u(q_t) + \theta q_t = \phi_t A_t$$

Fiat Money - Boom Phase

- First, note that nothing changes in the steady state, since $m_t = 0$ and there are no miners.
- In the boom phase, all producers mine if they have the ability to do so. This implies

$$\frac{\dot{\phi}_t}{\phi_t} = \rho - \alpha e^{-\delta t} \theta \frac{u'(q_t) - 1}{(1-\theta)u'(q_t) + \theta}.$$

- If $\delta = \infty$ we are back to the case where all producers can mine.
- If $\delta < \infty$, there is trade and money delivers a liquidity premium. This premium reduces the rate at which the value of money increases over time.
- In fact, if δ is small enough, the Boom Phase no longer exists and money always decreases in value over time.

Comments

- What is it about the money mining technology that creates and sets an end to the Boom Phase?
- The existence of delays in trade is important for the creation of the Boom Phase.
- The fact that the mining rate decreases in the stock of money is important to set an end to the Boom Phase.
- The endogeneity of money creation seems less important to either deliver the Boom Phase or to set an end to it.

Crypto-currencies

- Two features of the environment make it less appealing as a model of crypto-currencies.

  1. The path of money is exogenous for several crypto-currencies
  2. Mining is used to validate transactions

- The first issue is addressed in the paper.

- To highlight the flexibility of their model, let us consider an extension in which the second issue is also addressed.

Crypto-currencies

- The growth rate of money is decreasing in the stock of money.

$$\frac{\dot{A}_t}{A_t} = \pi(A_t).$$

- Transactions need to be validated by miners, say, $\alpha = m_t$.
- If miner exerts effort, she receives

$$\frac{\dot{A}_t + \gamma A_t}{m_t}$$

units of money. γA_t captures the need to tax money holders in case $\dot{A}_t = 0$ and there is no money creation.

Crypto-currencies

$$\frac{\dot{\phi}_t}{\phi_t} = \rho - \gamma - m_t\theta \frac{u'(q_t) - 1}{(1-\theta)u'(q_t) + \theta}$$

where

$$m_t = \begin{cases} 1 & \text{if } \frac{\dot{A}_t + \gamma A_t}{m_t}\phi_t > m_t(1-\theta)\left[u(q_t) - q_t\right] \\ [0,1] & \text{if } \frac{\dot{A}_t + \gamma A_t}{m_t}\phi_t = m_t(1-\theta)\left[u(q_t) - q_t\right] \\ 0 & \text{if } \frac{\dot{A}_t + \gamma A_t}{m_t}\phi_t < m_t(1-\theta)\left[u(q_t) - q_t\right] \end{cases}$$

and

$$(1-\theta)u(q_t) + \theta q_t = \phi_t A_t$$

Crypto-currencies - Steady-State

$$\rho - \gamma = m\theta \frac{u'(q) - 1}{(1-\theta)u'(q) + \theta}$$

$$\frac{\gamma\phi\overline{A}}{m} = m(1-\theta)\left[u(q) - q\right]$$

$$\phi\overline{A} = (1-\theta)u(q) + \theta q$$

- An increase in γ can lead to an increase in q and m.
- In other words, "inflation" benefits both the intensive and the extensive margin of trade

Conclusion

- There is a vast literature on the demand for money, much less work on the supply of money.
- The emergence of digital currencies has led to the need to fix this imbalance.
- This paper makes a nice contribution to this literature.
- Particularly interesting is the result that the properties of the money mining technology can lead to boom and bust trajectories in the value of fiat money.
- This result suggests an explanation to the bubbly like behavior that arguably one observes in the behavior of crypto-currencies.