Real Asset Backed Coins [1]

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January 21, 2020

[1] Preliminary and incomplete. Do not cite.

Overview

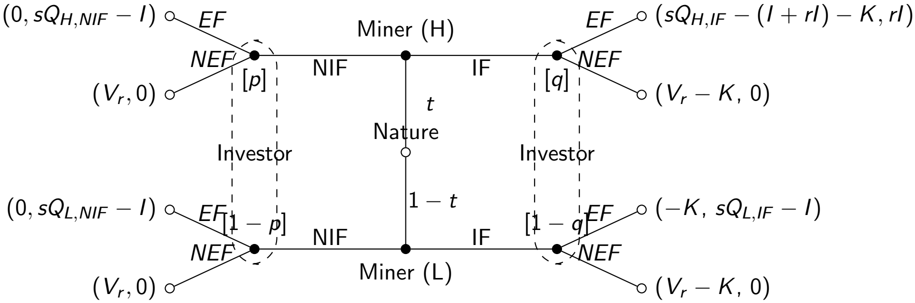
Introduction

- Productive communities in developing economies face severe problems along the entire productive value chain. Unbanked small producers lack access to formal credit markets.
- Generally, the root of these problems lays in asymmetric information.
- In the presence of these problems an underinvestment problem arises, which results in a lower overall society's output.

Introduction

- We develop a theoretical model that integrates a digital ecosystem, in the context of a Community Value Chain (CVC), with a Real Asset-Backed Coin (RABC)
- This token facilitates all payments by and to producers and providers and enhances credit access
- This results in an increase in community production and an overall benefitial impact in the economy
- The model shows that the existence of an asset-backed token supported by a digital Clearing House results in participants having a more effective monitoring of contractual obligations.

A traditional financial market



A traditional financial market

We make the following assumptions about payoffs :

- $s\ Q_{L,NIF} < s\ Q_{L,IF} < I < s\ Q_{H,NIF}$

$$\Rightarrow s\ Q_{L,NIF} - I < s\ Q_{L,IF} - I < 0$$

  and

$$s\ Q_{H,NIF} - I > 0$$

- $s\ Q_{H,IF} - (I + rI) - K > 0$

A traditional financial market

- This a dynamic bayesian game of incomplete information
- We solve for perfect bayesian equilibria
- Conditions for a unique separating equilibrium:

$$K > V_r$$

$$s \; Q_{H,IF} - (I + rI) - K > V_r$$

Extension to the basic model

- We consider a two period model: $t = 0$ and $t = 1$. In $t = 0$ the miner announces the intention to exploit the mine. She has no access to financial markets and her own type is not known to outside investors.
- Inside the CVC, there exists a Clearing House that charges an amount h to the producer for its services. In this case it issues a token which value is based on the unknown reserves of the mine.
- Miner has limited weatlh: $W_E < K$
- Simplified notation:

$$Q^* \equiv Q_{H,IF} \text{ and } Q^{**} \equiv Q_{L,IF}$$

Extension to the basic model

- Miner's limited wealth poses a problem in the traditional financial market model
- Here, it is solved by the digital Clearing House (CH)
- CH issues an amount m of "silver" coins (RABC) whose total value is equal to the total expected value of the production of the mine plus the amount provided by the investor.
- Sources of funds: $I + sQ$
- Use of funds: $Z + I(1 + r) + h$

$$sQ + I = Z + rI + h + \pi_M$$

The Clearing House

- Inside the CVC, all parties -miner, contractor and investor- agree to write contracts between them using the silver coins issued by the Clearing House rather than outside money ("dollars").
- It is the Clearing House the institution that regulates transactions and enforce written contracts. Its the embodiment of intelligent contracts made possible by blockchain technology.
- At time $t = 0$, the Clearing House provides the miner the silver coins issued, which in turn are used by the miner to pay for the required inputs and services.

The Miner and the Contractor

- The Miner must commit resources in a (dollar) amount of K to signal her type.
- The miner gets all the coins issued by the Clearing House and use them to pay for all the productive inputs.
- The main resources to exploit the mine, (labour, equipment, etc..) are provided by a contractor, which represent the supplier of intermediate goods and services to operate the mine. The dollar value of these resources is Z.
- The contractor can exert costly effort, ϵ, to improve the total production of the mine if he engages in the transmission of his expertise in the use of his inputs.

The Investor

- It is possible for "outside" investors to enter the community and provide the funds required for production. Investors provide an amount of funds equivalent $I = Z - K$ and he charges the miner an interest rate r_c in silver coins.

The silver coins

At time $t = 0$, the NPV of the mine is given by:

$$sQ^* - Z \tag{1}$$

Since the contractor can exert effort to enhance the value of production, the NPV of the mine can be expressed as follows:

$$NPV = sQ^*(\phi) - Z_i \tag{2}$$

$$NPV = \begin{cases} sQ^*\theta - Z_1 > 0 \\ sQ^* - Z_0 > 0 \end{cases} \tag{3}$$

The Clearing House issues an arbitrary amount m of coins. The dollar value of each is coin is then given by:

$$c = \frac{sQ^*(\phi) + I}{m} \tag{4}$$

Payoffs

Unique separating equilibrium implies $c = c_0 = E(c_1)$

- Contractor:

$$m_c E(c_1) = m_c(\frac{sQ^*\theta + Z_1 - K}{m}) - \epsilon \quad (5)$$

$$\Rightarrow \frac{m_c}{m}(sQ(\theta - 1) + (Z_1 - Z_0)) > \epsilon \quad (6)$$

- Investor:

$$m_I = \frac{(Z_1 - K)(1 + r_c)}{c_E} \quad (7)$$

- Miner:

$$m_M = m - m_h - m_c - m_I \quad (8)$$

where $m_h = \frac{h}{c_E}$. Accordingly , $c_E m_M > V_r$

Out of equilibium payoffs

- What if a low-reserve miner tries to bluff?
- Since she would be holding silver coins (to make payments and her profits), the following holds

$$c_E = \frac{sQ^*\theta + Z_1 - K}{m} = \frac{sQ^*\theta + I}{m} \tag{9}$$

$$c_B = \frac{sQ^{**}\theta + Z_1 - K}{m} = \frac{sQ^{**}\theta + I}{m} \tag{10}$$

- The amount of coins left for the miner is given by:

$$m_M = \frac{sQ^*\theta + I}{c_E} - \frac{h}{c_E} - \frac{I(1 + r_c)}{c_E} - \frac{Z_1}{c_E} \tag{11}$$

The dollar value of this amout of coins is therefore:

$$c_B m_M = \frac{c_B}{c_E}(sQ^*\theta - h - Ir_c - z_1) \tag{12}$$

Out of equilibrium payoffs

- The low value Miner will not have incentives to mimic the high value Miner as long as $c_B m_M < V_r$.
- Lets define the profits of a high value Miner as $P^* = sQ^*\theta - h - Ir_c - Z_1$.
- From equation (12),

$$\frac{c_B}{c_E} P^* < V_r \tag{13}$$

It follows that we obtain a truthful revelation outcome as long as:

$$sQ^{**}\theta < V_r(\frac{sQ^*\theta + I}{P^*}) - I \tag{14}$$

Conclusion

- We show that some of the common sources of underinvestment problems faced in environments of asymmetric information could eliminated, in this simple setup, with the use of the RABC.
- In the model, the Miner/Entrepreneur must invest in the project in order for the signal to be credible. The RABC and the Clearing House in the model allows the entrepreneur to provide the correct signal when she doesn't have enough resources to commit ex-ante.

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First Conference on Financial Stability and Sustainability

Lima 2020

Summary

Research Question

- Does the digital ecosystem improve the market misallocation (failure)?

The model ...

- describes a possible reason for underinvestment due to asymmetric information
  - The inclusion of a Real Asset Backed Coin (RABC) eliminates this problem
  - The RABC and the Clearing House allow the entrepreneur to send the right signal
- has two parts
  - Part I: traditional problem of asymmetric information (**signaling game**)
  - Part II: how the RABC within a Community Value Chain (CVC) could solve the "screening" problem

Comment 1: Basic Model Setup

Pure Strategies

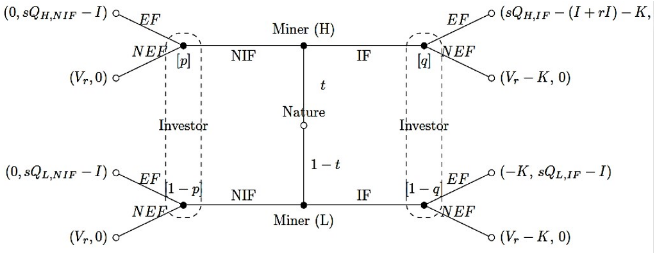
- Miner Strategies (m_H, m_L), Investor Strategies (a_{NIF}, a_{IF}), Payoffs? Beliefs? Bayesian Updating?

Assumptions

- $sQ_{L,NIF} < sQ_{L,IF} < I < sQ_{H,NIF}$
  $\Rightarrow sQ_{L,NIF} - I < sQ_{L,IF} - I < 0$ and $sQ_{H,NIF} - I > 0$
- $sQ_{H,NIF} - (I + rI) - K > 0$
- The role of K: Is it all or nothing?
  - *Another assumption states that if reserve**S** are high, the value of production covers the external investment even if the miner does not invest some internal resources into production.*
  - I guess ... $sQ(K)$ and sQ is the production

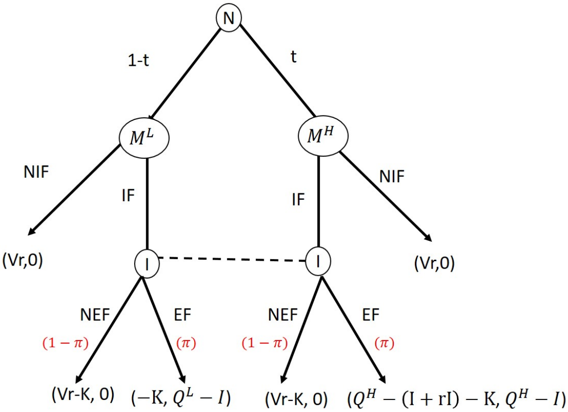
Comment 2: Basic Model Equilibrium

Extensive Form



- $sQ_{L,NIF} < sQ_{L,IF} < I < sQ_{H,NIF}$
  $\Rightarrow sQ_{L,NIF} - I < sQ_{L,IF} - I < 0$ and $sQ_{H,NIF} - I > 0$
- $sQ_{H,NIF} - (I + rI) - K > 0$
- If Miner plays "NIF" $\Rightarrow$ Investor plays "EF" $\Leftrightarrow p > \frac{I - sQ_{L,NIF}}{sQ_{H,NIF} - sQ_{L,NIF}}$
- If Miner plays "IF" $\Rightarrow$ Investor plays "EF" $\Leftrightarrow q > \frac{I - sQ_{L,IF}}{sQ_{H,IF} - sQ_{L,IF}}$

Comment 2: Basic Model Equilibrium



- If High, then it's rational for investors to lend, regardless of beliefs
- If Low, then it's rational for investors not to lend, regardless of beliefs
- Pooling: market directs capital to "unscreened" miners and wastes resources

Comment 3: Real-Asset-Backed-Coin Model

- One-period model because $t = 0$ and $t = 1 \Rightarrow$ no discounting factor, discounting for risk is not considered
- What is the role of W_E? $\Rightarrow$ reduce the noise of the signal?
- $Q_{high,if} = Q^*$ the high reserves
- Equation (4) $c = \frac{sQ^*(\phi)+I}{m}$
  - *"The Clearing House issues an arbitrary amount m of coins"*
- I guess that $Q^T = Q^H + (share)Q^L$