Oracle Taxation Theory

November 7, 2019

Oracle Problem

Goal

UMA's protocols allow synthetic assets to be traded on the blockchain

However, to evaluate synthetic assets we must be able to determine asset prices

Where can we get these asset prices?

We propose to use our Data Verification Machine (DVM) to produce these prices

DVM Summary:

- Distribute "vote tokens"
- Holders of "vote tokens" determine asset prices using a form of Schelling point game
- Buy back some amount of "vote tokens" from those who own them
- These buyback are funded by charging a fee to those who depend on the asset prices

DVM Risks

What are the risks of such a system?

- *Bribe attack*: Offer rewards to voters if they vote for an incorrect price which is dictated to them
- *Direct attack*: A single person purchases enough tokens to corrupt the system in order to swing asset prices in their favor
- *Indirect attack*: Change the reference price that most voters may base their votes on (i.e, Bloomberg...)

Our focus today will be on **direct attacks**

PfC $<$ CoC

Preventing Corruption

Our corruption prevention strategy revolves around a single inequality

$$\text{Profit from corruption} < \text{Cost of corruption}$$

System will be constructed to ensure that it is never economically profitable to perform a direct attack

Notation

- p_t: The price of the vote token in dollars at time t
- S_t: The number of outstanding vote tokens at time t
- M_t: The total margin that depends on the DVM at time t
- X_t: The dollar value of the buybacks administered at time t
- r: The risk-free interest rate
- γ: Fraction of margin that can be stolen when corrupted
- χ: The fraction of vote tokens required to corrupt system

Corruptible price

Can show that the price that prevents corruption is

$$p_t \geq 2\gamma \frac{M_t}{S_t}$$

Mechanism for preventing corruption

We will prevent corruption by taking actions that influence the price of the “vote token”

Note that, if markets are efficient, then

$$p_t S_t = E\left[\sum_{s=0}^{\infty} \left(\frac{1}{1+r}\right)^s X_{t+s}\right]$$

which means increasing current/future buybacks, while holding the number of tokens constant, will increase the current asset price

Deterministic Steady State Model

Steady state

In the steady state model, we consider an environment in which margin is constant,

$$M_t = \bar{M} \quad \forall t$$

We would like to know what the minimum amount of fees that can be charged in this environment

Must collect at least $r\bar{M}$

One can show that the minimum buyback that ensures the system is incorruptible is given by

$$\bar{X} = 2\gamma\bar{M}r$$

So, in the baseline case ($\gamma = \frac{1}{2}$), $\bar{X} = r\bar{M}$

Result

Consider a world in which the following three things are true:

1. Blockchains are widely used and accepted technology
2. UMA is widely used within DeFi
3. People believe UMA will be widely used within DeFi

Then we believe we can support annualized fees of 2%-5%.

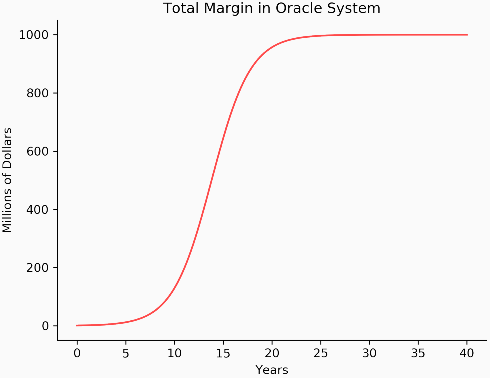
Deterministic Growth Model

Growth

Consider an environment in which the entire history of margin is known and that it is described by

$$M_{t+1} = (1+g)M_t\left(1+\frac{M_t}{\bar{M}}\right); \quad M_0$$

Growth Process



Minimize fees subject to no corruption

We solve for a buyback policy that allows for minimum amount of fees

$$\min_{T_t} E\left[\sum_{t=0}\left(\frac{1}{1+r}\right)^t T_t\right]$$

subject to

$$PfC_t \leq \frac{1}{2}P_t S_t = \frac{1}{2}E\left[\sum_{s=0}\left(\frac{1}{1+r}\right)^s X_{t+s}\right]$$

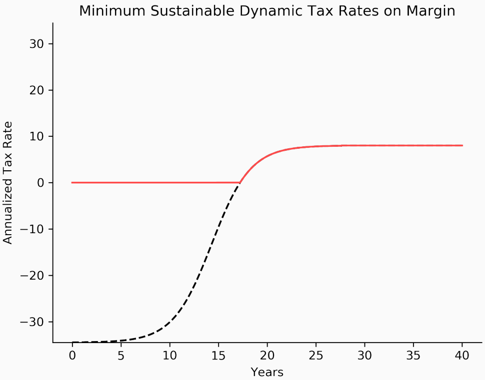
$$X_t = T_t$$

$$0 \leq T_t$$

$$T_t \leq \bar{\tau}\bar{M}$$

$$M_{t+1} = M_t + gM_t\left(1 + \frac{M_t}{\bar{M}}\right)$$

Minimize fees



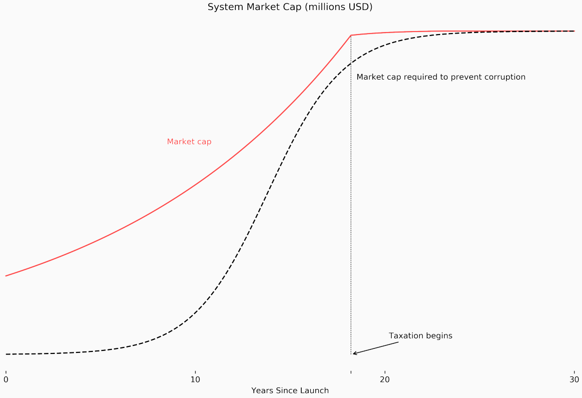
Forward looking fees

Our key take-away from the previous graph is that future promises of buybacks are enough to support no buybacks for a significant amount of time

This fact becomes obvious if you stare at the following equation:

$$\text{CoC}_t = \chi p_t S_t = \chi E \left[\sum_{s=0}^{\infty} \left(\frac{1}{1+r} \right) X_{t+s} \right]$$

Forward looking fees



Stochastic Model

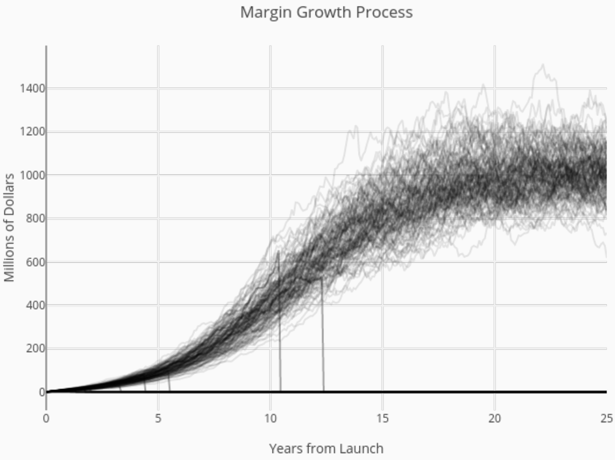
Stochastic Model

Up until now, everything has been completely deterministic

We now want to allow for margin growth to be stochastic

Margin process

We use a stochastic version of the logistic growth function



Rainy day fund

Up until now, the buybacks and fees were equal $T_t = X_t$ which was an outcome of the fact that previous models were deterministic and margin was monotonically increasing

It will be important that we allow for them to not be equal going forward.

We introduce a new variable, D_t, as the "rainy day fund" that we have saved up prior to period t, then our period-by-period budget constraint is described by

$$(1 + r)D_t + T_t \geq D_{t+1} + X_t$$

Choosing policy functions

We are allowed to pick two policies:

1. Buyback policy, $X^*(M_t)$
2. Fee policy, $T^*(D_t, M_t)$

What are our goals in picking these?

We set out to find policies that minimize the present discounted value of buybacks performed and impose non-volatile, but low, fees.

Two step process

Hard to choose an objective function that accurately reflects both concerns at once, so we use a two step optimization process:

1. Find a buyback policy, $X^*(M_t)$, that minimizes the present discounted value of buybacks while still securing the system
2. Find a fee policy, $T^*(D_t, M_t)$, that finds a low volatility tax policy which can fund the specified buyback policy

Formally...

Step 1:

$$\min_{X_t} E\left[\sum_t \left(\frac{1}{1+r}\right) X_t\right]$$

subject to

$$2PfC_t \leq E\left[\sum_{s=0}^{\infty} \left(\frac{1}{1+r}\right)^s X_{t+s}\right] \quad (\lambda_t)$$

$$X_t \geq 0 \quad (\mu_t)$$

Formally...

Step 2:

$$\min_{\{T_t\}} E\left[\sum_t \left(\frac{1}{1+r}\right)^t (T_t - \hat{\tau})^2\right]$$

subject to

$$T_t + (1+r)D_t \geq D_{t+1} + X_t^* \quad (\mu_t)$$

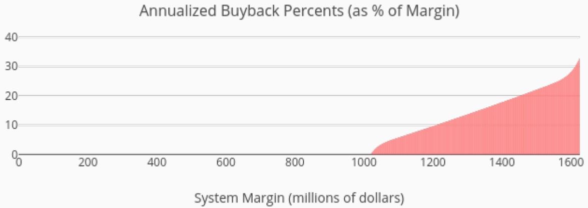
$$D_t \geq 0$$

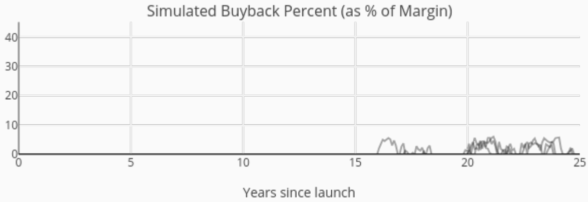
Numerical Example: Baseline

We set the following parameters in our baseline case:

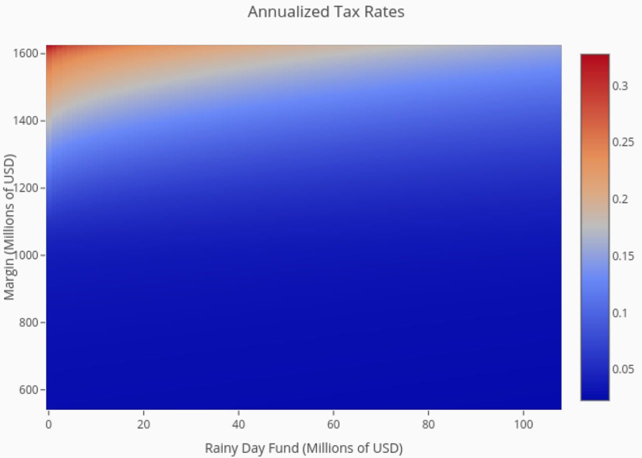
- One time period corresponds to one month
- Half of margin is seizable
- Annual risk-free interest rate of 2.5%
- Target annualized fee of 2% of margin

Buyback policy and simulated buybacks

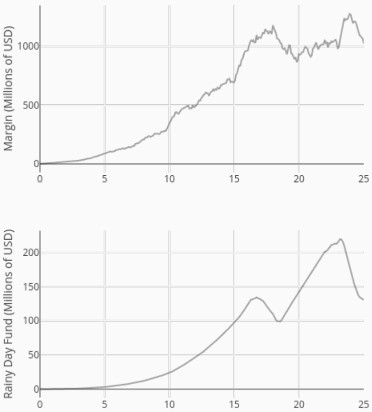




Annualized Tax Rates



Single simulation



Takeaways

Two Takeaways

- No reason to charge fees when system is small; the future expectation of buybacks can support system for a long time — Even with added failure risk
- A rainy day fund plus optimal shape of buybacks allows for system to charge relatively low and non-volatile fees