Oracle Taxation Theory

August 8, 2019

Goal Refresher

$PfC < CoC$

The purpose of the taxation (T_t) and buyback policies (X_t) is to ensure that the price of the token prevents 51% attacks. Formally, we want

$$\underbrace{\gamma M_t}_{\text{Profit from Corruption}} < \underbrace{\frac{1}{2} p_t S_t}_{\text{Cost of Corruption}}$$

This can be controlled by system because, if priced correctly, the token market cap should be

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

Last Time

Tax rates in deterministic world

We learned that, in a deterministic world, that tax rates

- Must eventually be roughly the same as the interest that we would like token holders to earn
- If people believe that the system margin will grow, then we can support relatively low taxes for a prolonged period of time

UMA

Stochastic Model

Why do we need stochastic?

In the deterministic model, there are no unexpected fluctuations or growth, and thus no risk

In a model where margin grows without risk, there's no need to have a rainy day fund or to provide any other form of self-insurance

In reality, we will need to ensure that there are funds to intevene and influence prices to ensure that $PfC < CoC$ — To think about the right way to intervene, we need a stochastic framework

Framework

Margin, M_t now follows a stochastic Markov process rather than a deterministic process

$$M_{t+1} = f(M_t, \varepsilon_{t+1})$$

Our goal will be to choose the "right" sequence of taxes to impose, $\{T_t\}$, and buybacks to make, $\{X_t\}$

What does "right" mean?

We have several, potentially competing goals to achieve with $\{T_t\}$ and $\{X_t\}$

- First of all, need to ensure $PfC < CoC$
- Minimize the tax costs and volatility
- Minimize the cost of buyback policy by minimizing $\{X_t\}$ (do we also care about volatility here too?)

Two steps to find policies

1. Find the buyback policy, $X^*(M_t)$, which solves

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

Subject to

$$PfC < CoC$$

2. Once we have a buyback policy, we want to determine how to finance the buybacks

$$\min_{\{T_t\}} \quad E\left[\sum_{s=0}^{\infty}\left(\frac{1}{1+r}\right)^s \frac{1}{2}T_t^2\right]$$

Subject to

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

Determine the Buybacks

In this context, a *Markov Perfect Strategy* is a buyback policy, $X^*(M_t) : M \to \mathcal{R}$ which is time-invariant.

Effectively, the buyback policy must only be a function of current margin, M_t.

Proposition: There exists a MP strategy $X^*(M_t)$ such that there is no function $X^*(M^t)$ which achieves a lower cost of buybacks

Determine the Buybacks

Buyback function will satisfy

$$2\gamma M_t = \sum_{s=0}^{\infty} \left(\frac{1}{1+r}\right)^s E\left[X^*(M_{t+1})|M_t\right]$$

If M_t follows a discrete Markov chain, can write $X^*(M)$ as

$$X = 2\gamma \left(I - \frac{1}{1+r}P\right) \begin{bmatrix} M_1 \\ M_2 \\ \vdots \\ M_N \end{bmatrix}$$

Two cases

Case 1: Persistent Margin

In the case of relatively persistent margin, the buyback levels are relatively inelastic and do not move much relative to margin — In one numerical example, for a $100,000 change in margin the buybacks only change by about $5,000.

Case 2: Transitory Margin

In the case of transitory (not persistent) margin, the buyback levels respond much more strongly — In one numerical example, for a $100,000 change in margin the buybacks change by about $75,000.