## 1 Introduction

We think the next logical experiment is to use the information signals available in today’s institutional infrastructure to create a new type of synthetic commodity. In this paper we first introduce Phoenix-Seal, a new synthetic commodity protocol, which propagates nominal exchange-rate information into token supply.

We then suggest that the incentives introduced by the Phoenix-Seal protocol’s design cannot be realized with existing price-based trading strategies, and instead call for the creation of new trading strategies that take an additional supply information signal into consideration. For this reason, we expect that Phxseals will produce a distinct volatility fingerprint.

## 2 Protocol

At a high level the Phoenix-Seal protocol propagates price-information into supply by reacting to nominal exchange-rate information. The protocol achieves this by actively seeking a price-supply equilibrium—and will automatically enter a state of unrest until it finds one. Consider the following example:

* Equilibrium 1 :

Alice has 1 Phxseal worth $1.

* Demand Increases :

Alice has 1 Phxseal worth $2.

* Equilibrium 2 :

Alice has 2 Phxseals each worth $1.

Whether Alice holds 1 Phxseal worth $2 or 2 Phxseals each worth $1, makes no difference in terms of net balance. The difference is the Phoenix-Seal protocol directly propagates price-information to each token owner through the count in their token balances. By expanding to and contracting from coin holders directly, a given user’s percent ownership remains fixed unless the user chooses to sell or buy more.

## 2.1 Two Simple Rules

The Phoenix-Seal protocol expands and contracts supply in one of two ways. Given a price target Pt, and

price threshold, δ:

1. if the nominal exchange rate between Phxseals and its target is > Pt + δ, the protocol responds by expanding to coin holders.
2. Phxseals always contracts by a 2% burn fee upon every transaction.

## 2.2 Supply Smoothing

The protocol sets supply targets algorithmically, and to avoid overcorrection it grades supply changes as

though they will distribute uniformly over the course of k days. For example:

* if the exchange rate is 1.5 Phxseals : 1, the price difference can be offset by increasing each wallet’s balance by 50%. Grading uniformly over k days, the protocol will increase wallet quantities by 50%/k on day zero.

The supply change ∆i/k is recomputed and executed no more than once every 24 hours. This operation

is stateless. Each day, the protocol recomputes the supply target based on the latest price difference and executes as though the targeted change will occur uniformly over the next k days without any memory of the previous day’s supply change.

## 2.3 Market Oracle & Expansion Coefficient

To absorb price information from the outside world, the protocol utilizes a market oracle system made up of whitelisted independent data providers who broadcast 24 hour volume weighted average price to a single on-chain Aggregator.

To enact supply changes automatically and simultaneously across wallets, the Aggregator updates a global coefficient of expansion referred to as the split Ratio no more than once every 24 hours. For detailed information on the market oracle and supply adjustment systems, please see the appendix.

## 2.4 Announcing Supply Changes

Each supply change operation is publicly logged and timestamped automatically to provide visibility into

when the next supply change will occur. Supply update values are computed based on a 24 hour volume weighted average of price, which is freely visible in the market. Additionally, the price values are publicly logged ahead of a rebase, so all participants have general visibility into whether a supply change will occur and in what measure. We will provide a simple visualization of this information, but anyone is free to construct their own as well.

## 3 Thinking Fast and Slow

The Phoenix-Seal protocol establishes a set of initial conditions and incentives for the network. There is no centralized oversight of price or supply in the Phoenix-Seal protocol. Rather, it depends on a decentralized network of actors. While the protocol propagates price information into supply, it’s the actors that propagate supply information back into price.

Recall that the Phoenix-Seal protocol programmatically sets equilibrium supply targets, which is important because the promise of elastic supply needs to be strictly enforced. However, changing supply does not mean that actors will correspondingly adjust their bids, nor will they do so in unison. Instead, actors will respond to supply changes based on how quickly or slowly they think others will respond.

## 3.1 Inductive Explanation

To illustrate it helps to separate fast actors, F A, who operate on short time windows; from slow actors, SA, who operate on long time windows. The total set of actors, T, is the combined set of fast and slow actors, T = F A ∪ SA.

To a slow actor who typically holds for long periods and only occasionally buys and sells, whether demand information is reflected in price or count (that is, price or supply) makes no difference with respect to their net balance.

But for a fast actor who benefits from near term trades, expansion and contraction events present a new market dynamic. Consider the following example:

* **Slow Actor**: Let’s imagine Alice is a slow actor. She checks in at time, t0 and sees that she has 1 Phxseal worth $1.2, later she checks in at t1 and sees that she now has 1.2 Phxseals each worth $1.
* Alice at t0:

1 coin, worth $1.2/coin

* Alice at t1:

1.2 coins, worth $1/coin

Since Alice’s USD net balance at t0 and t1 are equivalent, there isn’t any compelling reason for her to buy or sell before or after the state change. Not so for a fast actor:

* **Fast Actor (Expansion):** Let’s imagine Bob is a fast actor. He checks in before expansion at state t0, again while the system is expanding at state t1, and finally after expansion at state t2.
* Bob at t0:

1 coin, worth $1.2/coin

* Bob at t1:

1.2 coins, worth $1.2/coin

* Bob at t2:

1.2 coins, worth $1/coin

At t1 there’s a limited opportunity for Bob to sell more units than he could have at t0 for the same price, before other fast actors restore the price to its equilibrium value. The opposite is true in the event of contraction:

* **Fast Actor (Contraction):** Let’s imagine Charlie is a fast actor. He checks in before contraction at state t0, again while the system is contracting at state t1, and finally after contraction at state t2.
* Charlie at t0:

1 coin, worth $0.8/coin

* Charlie at t1:

0.8 coins, worth $0.8/coin

* Charlie at t2:

0.8 coins, worth $1/coin

Similarly, at t1 there’s a limited opportunity for fast actors to purchase a greater percentage of the network from Charlie at the same price they could have at t0 (should he be willing to sell), before other fast actors restore the price to its equilibrium value.

## 4 Volatility Fingerprint

By adjusting supply in response to demand, the Phoenix-Seal protocol applies a countercyclical pressure that is not present in current-generation digital assets. For this reason, it’s natural to ask whether Phxseal prices will move differently from other synthetic commodities. Below, we suggest that the movement pattern or volatility fingerprint generated by the Phoenix-Seal protocol will eventually have:

* A step-function-like market cap curve that alternates between dynamic states and equilibrium states
* A price curve that trades around the exchange rate target, with deviation during dynamic periods

To understand the potential behavior of Phxseals, we start by examining the proxies for gain and loss presented by the Phoenix-Seal protocol that do not exist in other synthetic commodities. How actors respond to these will determine the movement pattern of Phxseals’ price and supply.

## 4.1 What’s New?

Unlike current-generation synthetics, value changes in the Phoenix-Seal network can be attributed to supply in addition to price. Thus both the supply of units, S, and the price per unit, P, should be taken into consideration. The combination of these two signals can be represented by market cap, M, where M = P × S.

The Phoenix-Seal supply policy (described in Section 2) has three states:

* Expansion
* Contraction
* Equilibrium

Below, we explore the behavior of M = P × S across these three states, which we believe defines Phxseals potential volatility fingerprint.

## 4.2 Expansion

As discussed in Section 3, during expansion there is a window in time where fast actors have an opportunity to sell after the supply increases but before any price correction occurs. As long as there are enough fast actors willing to sell, price will decrease. This could produce price and supply patterns like those below:

As shown above, the price series P (left) could end roughly as it begins; however the corresponding supply series S (right) would end higher than where it began. To best evaluate the unique gain and loss relationship created, we examine the M = P × S or market cap series below:

Looking at M above, fast actors will see that, while t1 < t < t2, there is an opportunity to sell more Phxseals at a higher price than at the next equilibrium point M2. This occurs because the system expands proportionally to holders when the nominal exchange rate of Phxseals is > the price target threshold, and continues to expand daily until the price target returns.

An actor looking only at price cannot differentiate between selling at t < O and t > O, because by all

appearances the price series chart is symmetric. In contrast, an actor looking at P × S sees an asymmetric

opportunity, and can capitalize on it.

## 4.3 Contraction

The activity on contraction is simple, upon every transaction 2% of the transaction is removed from the total supply.

## 4.4 Equilibrium

Within the threshold band of the price target the supply policy does not intervene and supply remains constant. This would generate a price and supply pattern like below:

## 4.5 Predicted Output

Combining all these together suggests a potential price and supply movement pattern like below:

Price (above left) could remain around a certain exchange-rate, deviating during dynamic (dotted) periods. However, market cap could look like a step-function, alternating between dynamic (dotted) states and equilibrium states:

In practice, the time to exit a dynamic state is market dependent and may take multiple supply adjustment cycles to complete. Fast actors will therefore have an opportunity to act in each of these cycles. We expect that actors will attempt to predict where the next equilibrium market cap will land, derive their buy and sell targets from these predictions, and update targets as the market discovers its actual equilibrium point.

## 5 Conclusion

By our analysis above, we conclude that the market dynamics of Phxseals cannot be determined by price

alone, and require the consideration of supply in addition to price. As a result, the volatility fingerprint of Phxseals will be distinct from current-generation synthetic commodities.

While any structural distinction in movement pattern can benefit asset managers seeking to reduce diversifiable risk (Lintner 1965), the question of how correlated or uncorrelated Phxseals will be with existing synthetic commodities, remains open.

References

[1] Desan, C. (2015). Making Money: Coin, Currency, and the Coming of Capitalism. Oxford University

Press.

[2] Dowd, K. (2013). “Contemporary Private Monetary Systems.” Institute of Economic Affairs Mono-

graphs, Hobart Paper 174.

[3] Ferguson, N. (2008). The Ascent of Money: A Financial History of the World. Penguin.

[4] Goodspeed, T. (2018). “Kicking Away the Ladder? Cryptocurrencies in Historical Perspective.” Ap-

plied History Volume (Working Paper).

[5] Lintner, J. (1965). “Security Prices, Risk, and Maximal Gains from Diversification.” The Journal of

Finance.

[6] Liu, Y., and Tsyvinski, A. (2018). “Risk and Returns of Cryptocurrency.” National Bureau of Eco-

nomic Research (Working Paper).

[7] Nakamoto, S. (2008). “Bitcoin: A Peer-to-Peer Electronic Cash System.”

[8] Selgin, G. (2015). “Synthetic Commodity Money.” Journal of Financial Stability.

[9] Velde, F., and Sargent, T. (2002). “The Big Problem of Small Change.” Princeton University Press.

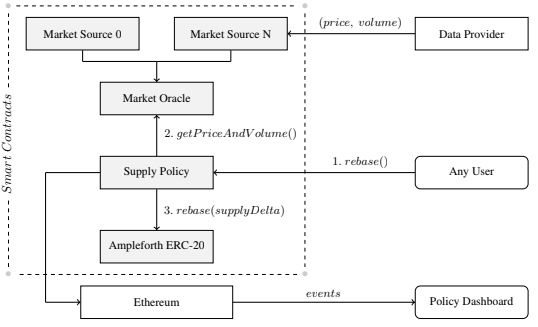
[10] Von Glahn, R. (1996). Fountain of Fortune University of Hawai’i Press.

[11] Wood, G. (2014). “Ethereum: A secure decentralised generalised transaction ledger.”

# Appendices

## A Software Architecture

Here we present an overview of the Phoenix-Seal architecture and its touch-points with the external world. At its core, the system consists of three smart contracts initially deployed on Ethereum: 1) the Phoenix-Seal ERC-20 Contract 2) the Market Oracle Contract, and 3) the Supply Policy Contract.



## A.1 Phoenix-Seal ERC-20 Contract

The Phoenix-Seal token implements the standard ERC-20 interface. It has one additional function called

rebase(uint256 epoch, int256 supplyDelta) and overwrites a number of public interfaces.

This method instructs the token contract to add to, or subtract from, the total supply of tokens, and is only callable by the Supply Policy Contract. All supply adjustments are symmetric across expansion and contraction such that:

If supply Delta is positive, new tokens are added to existing holders pro-quota.

To execute this process efficiently, we avoid generating a transaction for each wallet. Instead, Phoenix-Seal balances are internally represented by a hidden internal denomination. All external interfaces to the system reference the external denomination, while all internal operations reference the hidden internal denomination.

The conversion rate between the hidden internal denomination and the external denomination is controlled by an exchange rate that equals hidden Supply/uFragment Supply. This coefficient of expansion, sometimes referred to as the split Ratio, is represented rationally as the quotient of two numbers in the codebase.

By design, Solidity does not support floating point numbers. Rounding is a tricky business in accounting

software and this puts pressure on developers to take great care when thinking about numerical stability. In practice, we follow a stricter version of the EU’s guidelines on rounding numbers during currency conversion.

## A.2 Market Oracle Contract

The Market Oracle Contract provides data from the outside world to be used by the Supply Policy Contract. Specifically, it returns the 24hr volume-weighted Phxseal Price from exchanges. At launch, the oracle will have a trusted whitelist of sources and the price is calculated as the median of the sources.

1. Only whitelisted addresses can provide market data.
2. A market report must exist on-chain publicly for at least 1 hour before it can be used by the supply policy.
3. A market report will expire on-chain if a new report is not provided before 6 hours elapses.

## A.3 Supply Policy Contract

The Supply Policy Contract has a single external function, also called rebase(), this not to be confused

with the rebase method in the Phoenix-Seal ERC-20 Contract. “The Introduction of the Euro and the Rounding of Currency Amounts (1999)” is a good starting reference for practices related to currency conversions. We follow a stricter version of these rules in our implementation.

This rebase() method is publicly callable by anyone, but will only execute at most once every 24 hours.

Opening this method up, helps to remove us as a necessary central party in the system’s execution. If we fail to call rebase() for any reason, others are free to make that call in our place.

The rebase() method first queries the Market Oracle to get the current price. If the price is within price Threshold of the target price, no supply policy change is applied. Otherwise, the absolute supply Delta is equal to (price-target)\*total Supply/target. For example, if Phxseals are trading for $1.15, the absolute total Supply increase will be 15%.

Next, it applies a “rebase reaction lag” to dampen the supply change. At launch, the reaction lag will be

30 days. Finally, the Phoenix-Seal ERC-20 token is instructed to adjust its supply by the dampened value.

Continuing with the example above, the dampened increase would be (15% / 30 days) = 0.5% per day.

Due to the unpredictability of when transactions get mined into a block, and because at least 24 hours must pass before a rebase executes, there will always be slightly more than 24 hours between rebases. This means that, even though our rebase time is 24hrs, the rebase call will “drift” slightly over time. Based on our measurements on Ethereum’s Rinkeby testnet, we expect this drift to be about 1 hour per year. So if rebase calls execute at 0:00 UTC time on Jan 1st, they would execute 1:00 UTC a year later.

A public countdown timer to the next allowable rebase operation each day is displayed on the Phoenix-Seal Protocol dashboard.

## A.4 Multichain Phoenix-Seal

The Phoenix-Seal Protocol will initially be deployed on Ethereum, but the protocol is chain-agnostic and Phxseal tokens can exist simultaneously on many platforms.

The Supply Policy, Oracle, and future Governance modules will be deployed only once, on the chain with

the highest level of decentralization and and enough usage to guard against 51% attacks. Today, we believe that’s Ethereum. Long term, more Phoenix-Seal ERC-20 contracts, still governed by the same existing supply policy, can co-exist on other chains. The only requirement for future token platforms is that there is a bridge from the policy chain that allows atomic transfers of Phxseals and propagation of rebase transactions, and a virtual machine on the new platform powerful enough to support the required token arithmetic.

## B Choice of Information Signal

In today’s environment, the choice of having a fixed supply cap is reasonable. However, a fixed supply commodity, when used as a currency, brings with it well known problems.

Dowd estimates that under reasonable assumptions Bitcoin will have a long-run annual deflation rate of 1.5%. He also predicted that given a fixed supply of Bitcoin one could have either a significant take-up relative to existing currencies, or price activity that causes bubble-bust cycles, but not both. Bitcoin’s history has largely shown this to be correct, and hyperdeflation from price bubbles have had negative impacts on markets like the Silk Road where Bitcoin was the main currency (Dowd, 2013).