

Net Tao Flow Algorithm

In this brief document, we articulate and discuss a new mechanism for determining subnet emissions. Whereas the current mechanism fundamentally uses the subnet prices to determine the subnet emissions, this new protocol will instead measure the amount of TAO moving in or out of the subnet pool as the fundamental quantity. We will present the algorithm below, and follow this with a short discussion of its motivating properties.

Statement of Algorithm

For each subnet (indexed by i), we can consider the *net* TAO flow over one block to be the difference between the volume of buys and sells. This quantity is used to update an exponentially weighted moving average (EMA), denoted $S_i(t)$, which is given by

$$S_i(t) = (1-\alpha)S_i(t-1) + \alpha[\text{buys}_i - \text{sells}_i] \quad (1)$$

where α is the EMA parameter, that we can choose by some heuristic. This moving average S_i should be updated at each block. This value is then basically clamped and normalized, after which it determines (for each subnet) the fractional claim of each block emission of TAO.

First, we establish a lower limit L as the minimum EMA flow (or zero, if need be): $L = \min\{0, \min_i(S_i)\}$. We also allow for an alternative higher cut off A :

$$L = \max\{A, \min\{0, \min_i(S_i)\}\} \quad (2)$$

We then shift the S_i values by L and clamp any subnet who falls below zero as a result of the shift:

$$z_i := \max\{S_i - L, 0\} \quad (3)$$

This calibrates the flows relative to some baseline. Lastly, we normalize the set $\{z_i\}$, using an optional exponent parameter ($p \geq 1$):

$$\sigma_i := \frac{z_i^p}{\sum_k z_k^p} \quad (4)$$

This value of σ_i can be thought of as the *share* of the block emission that will go to the i^{th} subnet. In other words, we define the **tao_in** ($\Delta\tau_i$) as a fraction of the block emission ($\Delta\bar{\tau}$) according to

$$\Delta\tau_i = \left(\sigma_i / \sum_k \sigma_k\right) \Delta\bar{\tau} \quad (5)$$

Then, to maintain the pool price p_i , we must define the **alpha_in** ($\Delta\alpha_i$) according to

$$\Delta\alpha_i = \Delta\tau_i / p_i \quad (6)$$

Additionally, there may be conditions in which these quantities should be reduced (i.e. if the **alpha_in** were to exceed the **alpha_emission** cap, or if the sum of the subnet prices drops below 1 and we initiate a subsidy protocol, etc.).

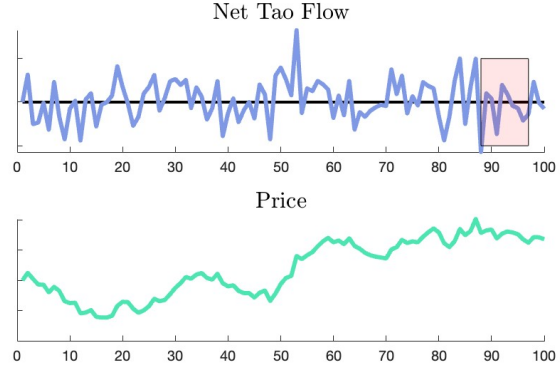
Motivation

The main idea behind the TAO flow injection mechanism can be phrased as the following:

The TAO injections awarded to subnets should fundamentally reward them for their ability to sequester TAO into their subnet pool. This is the primary activity that injections are meant to incentivize.

In some sense, the price (which we currently use) is simply a proxy measurement for the movement of TAO into the subnet pool (the more fundamental quantity). However, one could argue that there is a crucial flaw in doing this. Specifically, the flow of TAO into the pool is an *instantaneous* quantity, while the price is an *aggregate* quantity. In other words, the TAO flow could be negative, while the price is still elevated (because of a rise in the past).

Consider the figure below. We have a series of TAO flow quantities (randomly fluctuating between positive and negative values). The corresponding price evolution is plotted below (determined by the rules of a constant product pool).



Consider, for example, the period around $t=90$ (in the red box). Here, the flow of TAO into the pool is mostly negative, but the corresponding price is quite high due to a period of elevated TAO inflow during $t \in [50, 80]$. Thus, during this time around $t = 90$, the price based injections would handsomely reward a subnet that is mostly *losing* TAO in that moment.

In a more abstract sense, the price is related to the *integral* of the TAO flow, and thus represents a type of cumulative measure of TAO flow. Crucially, such a cumulative measure should not determine the *instantaneous* reward. In this sense, the flow based injection mechanism aligns better with the guiding principle stated above. Beyond this improvement in alignment of principles, it can also be more useful in practice, allowing for more configurability and fine grained control of the emission process.