Endaoed Exploratory Endeavours

A strategy to modelling market prices is critical to modelling the Chicken Bond mechanism, but having a good understanding of quantities is crucial for guiding the system. A strategy for modelling exogenous variables of demand is described. While a demand model rides a tangent to somewhere adjacent of where the Liquity team wanted to go, we suggest that the articulated paradigm can serve as a platform on which behavioural, economic or other assumptions can be slotted in with relative simplicity and modularity. Thus its potential as a modelling instrument is hinted at. The demand model is described with more detail in a separate piece as the real interest and focus of this submission is an exploration into quantity oriented policies that may be used in tandem with the interest rate policy (alpha) as a means of influencing the considerations of those engaging with the CB (chicken bond) mechanism. Due to time constraints and poor organisational habits, the two pieces have not been edited to an acceptable standard, and as a result, promises made and noted in the heat of the writing have not been followed through on. Furthermore, references to the apparitions have slipped through the cracks as well as typos, grammatical errors and clumsy phraseology for which we can only apologise and humbly ask of the reader, their patience and an open mind.

Introductory Preramble

Limitations from all directions have severely constrained the extent of exploration possible around the CB (chicken bond) mechanism, but for a coincidence of external circumstances and serendipity in recent months, an imprudent number of hours has been invested into this exploration. This piece approaches the CB mechanism from the perspective of quantitative economic analysis, as far as the smol brain of the author has come to presently understand it, and therefore the mathematical articulations as well are approached with this orientation in mind.

The most significant of those imposed circumstances and coincidences is a developing interest in the quantitative theory of money and quantitative monetary policy. Furthermore, imputing of behavioural assumptions on the CB-engaged population extends into domains beyond the competence of the author. Given those subjects mention and those not thus far, the reader may be suspicious as to the relevance of this submission. While the work herein is in not quite in the direction explicated by the submission criteria, those imprudently invested hours were not merely for amusement or as exercise, though it certainly checked both boxes. Rather, the thesis proposed in the following section suggests that there are yet untraced economic leads on the quantitative side of the mechanism that are not only worth investigating, but perhaps a yet uninvestigated responsibility of the Liquity team.

But what treasure which lies on the other side of these leads is so alluring as to inspire this degree of engagement from the author? The degree of rigour necessary could not be achieved here due to the earlier mentioned constraints, but top contours of the idea are provided with the hopes that they may lead to new understandings and potentially, new policy instruments for the protocol's repertoire which could also take and provide insight to the price model, just as would the alpha (/interest rate) policy, in order to induce desirable outcomes in the mechanism. More critically it will be proven later that the CB mechanism as presently defined in the wp (whitepaper) provided implicitly and immediately exposes a control panel

for the execution of an alternative set of policies. If the CB mechanism can be leveraged in this way, it would be an irresponsible oversight not to explore this unexplored front, since it is surely the obligation of the mechanism's designers to establish cursory handrails for all traversable paths as far as the eye can see from where the defined CB mechanism presently stands.

This exposition begins with the motivation for this approach with some economic discussion. The system variables are then categorised in terms of endogeneity and exogeneity with some exploration of loose analogies to existing macroeconomic policy. Based on the code provided by the Liquity team, a cadCad model has been formulated by ZeroGwei to see what behaviour may manifest when we intervened in variables according to the ideas later described. The idiosyncrasies (to be generous to myself) and flourishes contained herein will, no doubt, betray an almost complete lack of programming professionalism and perhaps, if inspected with squinted eyes at the right distance, betray the mathematical background of the author. The reader, being correct in this hypothesis might extend a degree of leniency in order to reach the small, sporadic insights which the author believes might be worth extracting and appropriating into a more comprehensive solution, even if this particular piece of work in its entirety is not of great value.

Economic Preramble

0. What is the thesis?
Having established the crucial role that the secondary-market price of bonded tokens play in timing an optimal bond redemption, the wp expounds, with heavy assumptions in hand, on price modelling for the bonded tokens. Then, having run simulations for the simplest case with rational actors, questions posed to the community ask for suggestions as to how even more complications could be reverse-jenga'd into the price-behavioural articulation which is already bursting at the seams with the combinatorial glut of variables and assumptions. While this modelling work is quite necessary, it is, again, quite beyond the abilities of the author. It should be stated explicitly that no criticism is intended by the somewhat tangential focus of this submission, rather a profitable evasion of the self-referential calculus clutter was serendipitously identified and of much greater interest than wading through a viscous swamp of self-referential differentials: an aspect of the mechanism has been left unexplored. The mechanism as defined implies the availability of quantity controls, and furthermore, it is the opinion of the author that price policies can be symbiotically paired with quantity policies in order to more effectively achieve the ultimate purpose of the CB mechanism. In order to get some sense of this unexplored domain, much detail has been elided in this section. Regrettably, naturally, this leaves much to be desired, but i've got other shit to do.

1. Using alpha policy can only yield blunt, imprecise results
The impact that the bonded token price has on churn of the flywheel's mass establishes a clear motivation for forecasting its value: with a good price model, the interest rate policy, denoted alpha, can be modified with some confidence as to how the impacts of the change could percolate through the system. Nothing disagreeable is found in this logic. With the rate policy in hand, a protocol can modify how attractive the bonding prospect is, and thus modify the behaviour of those that constitute the mass of the flywheel. One can hardly fail to see in this construct the

resemblance to that well known monetary policy involving interest rate changes utilised by central banks. With rate policy in hand, central banks (amusingly, also with acronym 'CB') indirectly modify the profitability of engaging in their economy, thus raising or lowering fervour of activity.

1.1. Modelling things dependent on alpha gets complicated fast

The analogy to central bank rates is however, limited on many fronts and so the instinct to short-hand away nuances of the alpha policy must be held back. Where the analogy breaks there is an insight: A token that is engaged with the CB mechanism has far fewer possible stages than does a unit of freshly fabricated Fed fiat. Unlike a unit of fiat which has before it an almost infinite landscape of hands and accounts to traverse with a lifespan likely measured in decades, the token's relevance is high at all stages to all stages and moves with relatively high velocity. As recognised and hinted in section 4.3.4, the changes due to modified alpha echo in feedback loops through the mechanism (that exponential form p_f being linear wrt a^t smells somewhat differential eqn-y. Impressively the wp displays great self-control in not once raise a differential equation). Thus, with the intention of understanding price, the wp dramatically flattens complexity with a series of assumptions and attempts to reverse engineer the self-referential rube-goldberg a, which is, with slightly loosened assumptions, a function of alpha. The point emphasised is that it is easy to see that this system is really complex in its dynamics.

1.2. The alpha policy does determines profitability, but it is a tool without nuance

However the parameters and variables for a useful model of a end up manifesting, it strikes as very unlikely that incremental policy changes will typically cause unexpected or dramatic behaviours; to reject this proposition puts a question-mark on the efforts of the entire wp. Thus I propose the likely uncontroversial assumption that: Generally, the impacts of a marginal change in alpha are mechanistically contiguous - determined and theoretically describable. This might be so in a real implementation of the CB mechanism, but it would also certainly be so for any model of the implementation. Taking this assumption and the points made previously,

there's a level of granular, nuanced control of the CB system that is not accessible with only the alpha policy. Say, to be very abstract, a protocol wishes for a system variables to move in a certain way while keeping another at its current nominal value, but in deriving the appropriate policy to achieve these motions, it is discovered that the changes are contradictory on the level of necessary alpha policy update - one needs a raised alpha, but the other condition requires it lowered. In this situation, the protocol must compromise. Of course, the alpha policy by the terms of its employment in the system still determines the profitability of engagement, so while It can only be assumed, as yet we do not have a good model, it would surely be of great surprise if the single lever alpha policy could produce a more nuanced influence than setting the system to degrees of up-only or down-spiral. From experience we know that up-only is a game played on mephistophelian turf, and we need only search on coingecko the forgotten names of prior bull runs to remind ourselves of how this plays out. Perhaps a different approach could shed light: though it seem almost childish in its bluntness, since we are trying to influence momentum, could we not instead target an intervention at the distribution of weights directly?

2. Quantity controls can also influence the system

Here we can start to approach the thesis by looking at the pragmatic value of quantity policies. The first proposition that will be scrutinised is that quantity controls are available in the CB mechanism as presently defined. To prove that quantitative policies are possible and accessible in the presented system, we must first define what is meant by quantitative policy. Accessibility will come almost immediately as it is quite trivial, but will be explicitly mentioned for completeness sake. Only then can we explore the more demanding and motivating sub-propositions of the thesis; that a protocol may influence a system with greater nuance and precision via quantity policies than can be achieved with the alpha policy.

2.1. What are the quantitative policies?

The unique context of the CB mechanism begs of the reader an open mind when the well-known terms of quantitative policy are revealed. The policies will be described in detail and it will soon become clear that the

suggestions contained here will not match what is suggested by the infamous terminology. Quantitative policies are those that intervene in quantity measures. The most powerful are those which are already implicitly available in the CB mechanism as defined: Injections or removal of capital at any stage of the CB mechanism. Thus, we can start to think about chicken-equivalents of open bond market operations, quantitative easing and tightening. There is one other quantitative policy which is perhaps less significant, but is proposed since it could still be useful in certain market conditions. It is however, a policy that is 1. not available in the CB mechanism as currently defined. 2. better described as a fiscal policy than monetary, but whatever; after all, the interest here is influencing quantities: To employing what is denoted herein the beta rate; simply, the proportion of a chicken-in that makes it into the reserve bucket as opposed to the permanent bucket. Thus we have loosely defined the primary quantitative policies: direct market operations for easing and tightening, and the fiscal-ish beta rate.

2.2 Quantitative policies are easily accessible to any protocol that implements the CB mechanism

Given the loose definitions above, it is trivial to see how a protocol can access the main quantitative policies: simply maintaining a protocol owned portfolio that touches all stages of the CB mechanism. With a sufficiently large portfolio, the protocol can intervene in a specific bucket or secondary market to guide or nudge any stage or market directly. Thus the protocol can achieve states of the system that would be paradoxical with only the alpha policy. For example, a rising average bond age can be popped manually by having the protocol redeem its own bonds, and furthermore, by strategically choosing those bonds to chicken in and out, the TKN and bTKN pools can also be held relatively constant along some desired axis. Questions about the origins of funds to acquire the portfolio are important, but not addressed here as that is a fiscal matter for the protocol to determine for itself. Once a such a portfolio is achieved, the protocol may also be earning some surplus from it and naturally, this spare capital can be deployed however the protocol wishes (Maintaining the pf, buy backs, helicopter money, funding projects).

2.3. The policies are probably most effective used cooperatively

From the formulation in the wp, is appears that the CB mechanism is intended to be a permanent feature of a protocol's economic ecosystem. If it is to be relevant for the long term, it must be responsive to the waxing and waning of status quo. Considering the CB mechanism with the macro lens and splicing in some Sun Tzu, one last concern is raised involving the alpha policy that the author has not been able (bothered) to find any discussion of thus far: Given the goal of acquiring POL, should there not be self-imposed upper bounds of some kind, whereupon the protocol's endeavour enters endemicity? Better that the bounds on growth are well defined than to potentially be crushed under those forcefully and arbitrarily imposed by a whimsical and indifferent market. Implicit in this suggestion is the proposition that a protocol need not grab as much POL as it possibly can as fast as it can. Perhaps, POL acquisition strategies ought to be laid out clearly, and this would include a target. Though the rationale is not worked through in much detail here, it is at least reasonable that there must exist some practical upper-bound budget on the amount of POL is available for any level of incentive. As the alpha grows, as the proportion of liquidity suspended in permanent and reserved POL grows, the marginal impact of alpha must diminish. Again playing fast and loose with analogies, a successful CB strategy that is infinite horizon and greedy could end up in a place resembling a BOJ situation, where the Japanese central banks ended up owning the overwhelming majority of their country's entire stock market. Thus, there is at least this reason to be frugal with the alpha policy, as it directly taps into the total available market.

Economics

We have run out of time, but an outline of the arguments I wish to have made is left below. The details and exact wording of points always evolves as they are actually fleshed out, so these should be taken with a grain of salt, but they still do provide that top contour.

1. qty ctrl works because the exog vars that we intend on influencing with the alpha are also exposed to impacts on quantity

2. Some examples of how price and quantity policy effects can be interchangeable

2.1. Raising alpha can be approximated with decreased beta in certain market conditions

2.2. Protocol owned portfolio of bonds/btkns/tkns/permanent bucket can and should be leveraged to achieve quantity controls

2.3. Quantity controls can achieve changes in momentum

2.4. An example of some control that is accessible through quantity that is not accessible by price

3. Interest policy modulates demand for external TKN to enter the CB mechanism

3.1 Quantitative policy modulates the demand of internal TKN to enter certain stages