Havven: a stablecoin system
v0.4

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Abstract

There is currently no effective decentralised unit of account. Previous attempts to create stable tokens have either relied on significant centralisation or have been undermined by their complexity. We present Havven, a representative money system which seeks to achieve price stability with respect to an external asset. Havven is a dual-token solution, composed of a stabilised exchange token and the reserve token which backs it. Users are incentivised to maintain this distributed reserve, and to manage the stable token supply so that it is in proportion with the value of the collateral. Because the collateral is encapsulated entirely within the system and distributed among its users, we remove the need for a trusted central authority. Such a stable cryptocurrency, useful for everyday economic purposes, will accelerat‘e the adoption of distributed ledger technology.

Incorporate white paper criticisms.

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2 Introduction

2.1 Money and Cryptocurrencies

There are three primary functions of money: to act as a unit of account, a medium of exchange and as a store of value. In addition, money should ideally exhibit durability, portability, divisibility, uniformity, limited supply, and acceptability. Money has become almost invisible over the past few decades as payment technology has advanced. Because of this, it is often lost upon users of money that it is itself a technology that can be improved. Specifically, this means improving the performance of our six desirable properties.

Bitcoin is an impressive technological advancement upon existing forms of money which simultaneously improves durability, portability, and divisibility. Further, it does so without requiring the enforcement of a nation state from which to derive its value. The Bitcoin supply is, therefore, not subject to control by any central authority.

It is precisely its fixed monetary policy which has protected Bitcoin from debasement or devaluation, allowing it to outperform other forms of money as a store of value. Increased adoption has tended to drive the price up over time; unfortunately the fixed money supply has created the potential for short-run volatility, because there is no mechanism within Bitcoin that can adjust to changing demand for the currency.

Thus it has tended to be a poor medium of exchange and an even worse unit of account. In order for something to perform well as a medium of exchange or unit of account it must remain relatively stable against other goods and services because money is ultimately a good that other goods are denominated in. If the price of money as a good is too variable then it becomes less useful as a denominator of other goods.

2.2 Stablecoins

A stablecoin is a cryptocurrency designed for price stability, such that it can function as both a medium of exchange and unit of account. It should ideally be as effective for making payments as fiat currencies like the US Dollar, but still retain the desirable characteristics of Bitcoin; transaction immutability, censorship resistance and decentralisation.

Cryptocurrencies are in these ways a far better form of money, but have been significantly hindered in their adoption by volatility caused by the fact that as decentralised systems, they have tended to have relatively inflexible internal monetary policies. Hence stability continues to be one of the most valuable and yet the most elusive characteristics for the technology. Clearly, the ability to create alternative monetary policies within cryptoeconomic systems is still new,

and significant research into stable monetary frameworks for cryptocurrencies is required.

2.3 Havven

The Havven system is a novel form of representative money where there is no requirement for a physical asset, thus the problem of trust and custodianship is removed. The asset we use to back our stablecoin is the pool of reserve tokens, contained within the system itself. These tokens reflect participation in the system, and are a proxy for its value. Havven generates fees from users who transact in the stablecoin; and distributes them among the holders of the reserve token, compensating them for underpinning the system. Thus Havven rewards those who actively participate in maintaining it and charges those who passively utilise it. To maintain stability, Havven includes market incentives that manage the supply of the exchange token such that its price mirrors that of the asset it tracks.

Because we have created a system that generates cash flow for participants we now have an asset which has a defined market value and can be used as the collateral to support the stablecoin. The key to this is that the value of the system is measured in USD. This allows us to issue a stablecoin which can be presented and redeemed for a percentage of the collateral tokens valued at 1 USD. Backing a stablecoin in this way is beneficial because such a cryptoeconomic system does not require trust in a centralised party; each participant has full transparency over how many tokens have been issued against the available collateral at all times.

The two linked tokens and the complex of incentives for stability are defined below:

Havvens: The collateral token, whose supply is static. The capitalisation of the havvens in the market reflects the system's aggregate value, and the reserve which backs the stablecoin. Thus, users who hold havvens take on the role of maintaining stability. Following bitcoin, the Havven system will appear in upper case and singular; while the havven token will be lower case and may be plural.

Nomins: The stablecoin itself, whose supply floats. Its price measured in fiat currency should be relatively stable. Other than price stability, the system should also encourage some adequate level of liquidity for nomins to act as a useful medium of exchange. The nomin has value because it can be redeemed directly from the system for a fraction of havvens worth 1 USD.

Each holder of havvens is granted the right to issue a value of nomins in proportion to the USD value of the havvens they hold and are willing to place into escrow. If the user wishes to redeem their escrowed havvens, they must present the system with nomins in order to free their havvens and trade them again. The

holders of this token provide both collateral and liquidity, and in so doing assume some level of risk. To compensate this risk, such nomin-issuers will be rewarded with fees the system levies automatically as part of its normal operation.

This issuance mechanism allows nomins to act as a form of representative money, where each nomin represents a share in the havven value held in reserve. Nomins derive value insofar as they provide a superior medium of exchange, and are effectively redeemable for a constant value of the denominating asset. In this paper, we use USD as this asset, but this could be any external and appropriately fungible asset, such as a commodity or a fiat currency.

In this manner, the system incentivises the issuance and destruction of nomins so that the value of the nomin pool expands and contracts in proportion with the total value of havvens backing them. If prices change exogenously, then the system is designed to provide incentives for actors to counteract that change.

The Havven system is relieved of the obligation to respond to major macroeconomic conditions, as it benefits from the stabilisation efforts of large institutions acting in fiat markets. As Havven has the freedom to significantly overcollateralise its pool of circulating currency, it insulates itself against dramatic corrections in the havven market. Thus Havven acts as a bridge between fiat currency and cryptocurrency - a hybrid of the two technologies which possesses the advantages of both.

2.4 Rationale

In his discussion of Hayek money[?], Ametrano correctly makes the point that, due to its volatility and constrained supply, Bitcoin serves the purpose of crypto-gold much better than it does crypto-unit-of-account. By contrast, governments – which mint their own fiat currencies – can and do execute discretionary stabilisation policies to manipulate the circulating supply. This powerful lever is not available to Bitcoin and other supply-constrained currencies of its type, but a cryptocurrency whose monetary policy is algorithmically countercyclical rather than deflationary could inherit the desirable characteristics of both monetary paradigms. It should be possible to automatically provide incentives for the issuance and destruction of tokens according to demand. Users of such a currency would be allowed to back it while the system automatically seeks to expand and contract the money supply as its backing reserve fluctuates in value.

Clearly, the introduction of a new cryptocurrency in isolation offers no additional value given the existing and established alternatives such as Bitcoin and Ethereum. Havven thus seeks to derive value from the addition of **stability** to its inherited properties as a modern cryptocurrency. It is designed to provide a practical medium of exchange, without compromising the benefits that decentralisation offers in order to substantially improve the technology of money. There are many applications which Bitcoin's inherently deflationary monetary policy

and volatility presently make impossible: any token which is able to demonstrate an increment in utility on these fronts over both fiat and cryptocurrencies will significantly enhance the uptake of cryptoeconomic technology.

I think we need to add the specific rationale of why we're choosing to the system itself as the backing collateral over alternative approaches in this section.

3 Design Considerations

Havven works by providing a set of market incentives that support the stability of nomin value with respect to an external asset.

Address how to maintain baseline demand.

Address the role of the Havven foundation.

Outline basic verbs for market players.

Move analytical subsections from functional description section to the qualitative analysis and/or rationale sections.

3.1 Investment incentives

We consider the reasons why any rational actor would buy havvens. A potential buyer has at least three avenues for making money in Havven:

Capital gains due to the appreciation of havvens: Due to its constrained supply, and the intrinsic utility of the stablecoin that it backs, it's reasonable to assume that havvens will appreciate in price.

Interest accrued from fees: If the price of havvens stabilises for long periods of time, fees may be the only source of revenue. Ideally fees are set at a level where they are both high enough to be an incentive for rent-seekers to hold havvens in the long term (thus assuming the risk of providing collateral for the system) and low enough not to be a disincentive for ordinary users to transact in nomins. It is desirable, perhaps in a future world dominated by micropayments, for these fees to be negligible for end users, while still being macroeconomically important for the system, and for those who capitalise it.

Arbitrage profit: It is the arbitrageurs who will ultimately bring the price of nomins back into balance by a triangular circuit through nomins, havvens, and the external (crypto or fiat) markets. Arbitrageurs might hold havvens for a short time in order to pursue this strategy.

3.2 Fees

There are several key considerations with respect to fee design:

3.2.1 Fee design considerations

The purpose of fees Fees are intended to be redistributed to actors who support the stability of the system. A fee pool will be distributed periodically for this purpose. If the system determines that the nomin price is too low, then fees could be burned. If the price is too high then the system could sell these back into the system at a discounted rate. The fee collection rate will also be a direct measure of the velocity of money in Havven. It's in the interest of havven holders to maximise liquidity in order to maximise their return.

Fee beneficiaries One possibility would be simply to award fees to any holder of havvens, but in this situation holders can get all the benefit without taking any risk. Although in the aggregate, it would be better for havven-holders if everyone issued nomins, the marginal return for any single player (who cannot issue a large fraction of all circulating nomins) of actually issuing them would not outweigh the risk they take on in doing so. If a user can issue 1% of circulating nomins, then doing so will only increase their fee takings by 1%. Hence rational actors would not be incentivised to issue nomins at all. This is a classic tragedy of the commons.
In order to avoid this situation, we must improve the marginal benefit of issuing nomins into circulation. Hence, fees must be paid to those who *issue* nomins, not just those who hold havvens.

Fee collection The system can charge fees whenever any value is transferred, or any state is updated. Different fee rates have different macroeconomic effects. We might in general like to set higher havven than nomin transfer fees, making the stablecoin itself a lower friction market in order to incentivise its use for exchange. Meanwhile, issuance and redemption fees will change the difficulty of entering and exiting the issuance game.

It is also possible for fees to float. The fee schedule could be altered dynamically in order to stabilise the system. It is even conceivable that the system could set negative fee rates if it needed to and charge punitive fees if a user is above the targeted utilisation ratio. For example, if nomin liquidity is low, meaning the system wants to incentivise issuance, then nomin transfer fees could increase, thus having the combined effect of increasing the interest accrued by issuers (thus incentivising issuance) and at the same time making it more expensive to transact in nomins. This would reduce demand and decrease the liquidity requirements.

Of note, fees are antithetical to arbitrage. The higher the fee, the higher the transaction friction, and the harder it is to make money by arbitrage. For example,

if exchange fees amount to 1% per trade, then a full arbitrage cycle between all three markets, (nomins, havvens, and fiat) will cost in excess of 3%. So it would not make sense to undertake arbitrage until such a time as the quoted exchange rate is misvalued by more than 3% relative to the cross exchange rate. Hence, fees compete with arbitrage to stabilise price. Lower fees allow tighter stabilisation, within a window exactly in proportion with the fee rates themselves.

3.3 Encouraging liquidity

It's desirable that when actors issue nomins they are actually injected into the liquidity pool for their intended use, rather than being held by the same actor in order to benefit from both the receipt of fees while retaining the option of using those nomins to rapidly release their havvens. In this manner they would accrue fees, but take on none of the risk of spending those nomins, for they always have an instantaneous option to liquidate their position and escape. On the other hand, an actor who had done the economically-desirable thing and issued nomins to the market would be forced to buy them back before redeeming their escrowed havvens.

3.3.1 Non-discretionary Issuance

One possibility is to simply provide an issuer no control over the tokens they issue. That is, when a quantity of nomins is issued, they are generated by the system, which then places a sell order at the current going rate for that quantity on an exchange on the behalf of the issuer. When the order is filled, the proceeds in ether are remitted to the issuer.

Conversely, when a quantity of nomins is burned, they must first be obtained from the open market. In this way, a user would indicate an intention to burn, providing sufficient value to buy the proposed quantity of nomins, and the system would bid for that quantity on their behalf, thereby liquidating the user's havven position once the nomins have been obtained.

So one might consider there to be a formal distinction between wallets that issue tokens and those that do not. In this vein, one might envisage an extra fee to be charged to directly transfer nomins (rather than buying from the market) into a wallet that has an outstanding quantity of nomins it has previously issued, but not burnt. The result of this is that it would be less reasonable for an agent to sit on nomins in order to burn them in future as it is more advantageous in times of relative stability to simply buy them from the market.

3.4 Price discovery

One of the key challenges with denominating a cryptocurrency in a fiat currency is the fundamental link this creates to the centralised world. When the denominating currency exists external to the blockchain ecosystem, some bridge must be built so that the system can act with knowledge of external information. We recognise that a decentralised price-finding mechanism would be our preferred approach. Research into this mechanism is on our horizon, and future versions of this white paper will contain our results. However, in order to reclaim system performance, we can trade some of the trustlessness of the design, for example by a trusted "Oracle" service, which transmits knowledge of the external world into the system, building a causal link.

3.5 Utilisation Ratio

Even though rational actor modelling suggests that the price of nomins and havvens will equilibrilate given that an agent may pay up to some multiple of the market value of a nomin in order to release escrowed havvens, we are aware that there may be some prevailing macroeconomic or psychological influences relating to an undercollateralised position (i.e. if the value of the collateral pool is less than the issued stablecoin). As such, our modelling incorporates the notion of a "utilisation ratio" $0 < U < 1$, such that the system is over-collateralised in an attempt to counteract these potential issues. It may be that resolving an optimised utilisation ratio is beyond the ability of our agent-based modelling to determine, and as such, selecting this may need to be informed by the activity of a live system. Thus it is currently intended for Havven to initially include in its governance model the power to correct the utilisation ratio. This power can be removed over time as the system is proven, perhaps directly linked to some parametric milestones such as nomin velocity and stability.

4 System Description

Havven is designed to incentivise stability in a decentralised cryptocurrency denominated in some external currency, such as the USD. The dual-token system is combined with a set of novel incentive mechanisms designed to stabilise the price of one of the two tokens. The first token is the havven token, HAV - to avoid confusion with the system itself - and the nomin, NOM (short for denominator).

HAV serves two functions:

1. To provide the system with collateral (the system itself is tokenised).
2. To allow actors to contribute to the price stabilisation process through a set of incentives.

The second token, NOM, is the stablecoin. The purpose of NOM is to track the price of a chosen external denominating currency via the actions of HAV token holders; holders of HAV participate in modifying the level of supply in the NOM market such that the market price of NOM is maximally stable.

4.1 Incentive Layering

We classify the various incentives that can be applied in a stablecoin system. Note that any subset of these can be linearly combined in order to produce a sophisticated and powerful incentive structure. Havven's approach to achieving price stability is to be as passive as possible and only switch on higher levels of incentivisation when necessary. The order in which these categories appear is the order in which they are applied:

Overcollateralisation The basis for price stability within Havven is overcollateralisation of stablecoin value. This means the value of the escrowed collateral backing the stablecoin is strictly greater than the value of NOM in circulation. In Havven, this ratio of NOM to HAV is known as the utilisation ratio.

Fees The second layer of economic incentives for HAV holders is to provide them with fees in accordance with their performance in adjusting the supply of NOM. These fees are generated from small charges on all NOM transfers. The fees are directed to the HAV holders as a reward for helping maintain the correct supply of NOM.

Interest Rates Interest rates on HAV can be applied in addition to the application of fees, in either fixed or floating HAV supply regimes. Interest rates will be discussed in a future iteration of the whitepaper.

Collateral Recovery As a final layer of incentives, forced recovery of an actor's escrowed HAV may be required in order to equilibriate individual positions of utilisation ratio. Collateral recovery will be discussed in a future iteration of the whitepaper.

4.2 Overcollateralisation

We first introduce the core system variables:

$$H = \text{Quantity of HAV}, \qquad N = \text{Quantity of NOM},$$
$$P_h = \text{HAV Price}, \qquad P_n = \text{NOM Price}.$$

All HAV tokens are created in the initial system state, so H is constant. The quantity of NOM, N, floats in response to the actions of HAV holders, who, for the most part, are assumed to act in accordance with their incentives, thereby encouraging the NOM price, P_n, to stabilise with changes in demand.

4.2.1 Nomin Supply Control

NOM can only be issued when a HAV holder decides to escrow some number of HAV under their control. Once the HAV have been escrowed (via smart contract) a quantity of NOM are generated equal in value to the value of escrowed HAV multiplied by the maximum utilisation ratio. This ensures the value of the NOM that is produced is less than the value of the backing HAV collateral.

The system then immediately places a **limit sell** order with a price of $1 on an exchange (such as a dedicated decentralised exchange for HAV and NOM trading). This means that the NOM will be sold at the current market price, down to a minimum price of $1 USD. If we assume implementation on Ethereum, then the NOM are sold for an amount of ETH valued at $1, with the proceeds of the sale remitted to the issuer.

It is important for the proper functioning of the system that the pool of NOM is always overcollateralized by the value of HAV. The **utilisation ratio** is what initialises this property.

4.2.2 Utilisation Ratio

The utilisation ratio is defined by the total value of NOM against the total value of HAV:

$$U = \frac{P_n * N}{P_h * H}$$

Intuitively, if $U = 1$, the value of NOM and HAV are equal. Hence, given our overcollateralisation property, our target $U < 1$. To do this, Havven only allows the issuance of NOM up to a maximum utilisation ratio.

4.2.3 Collateralisation Target

Given the need to adjust the supply of NOM, a target utilisation ratio is defined as the point at which maximum incentives are applied:

$$0 \leq U \leq U_{max} \leq 1.$$

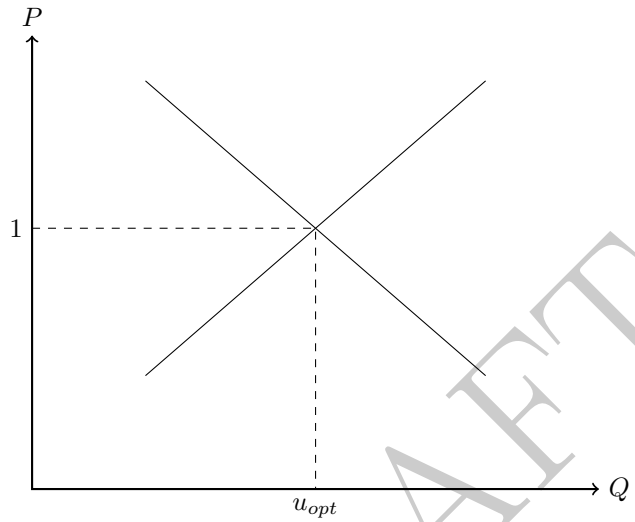
Because individual HAV holders have a unique utilisation ratio, U_i, the system can measure the degree to which their U_i is above or below the target and adjust their incentives accordingly. In this way the system incentivises the creation and destruction of NOM. U_{target} is defined formally below in terms of P_n (as NOM price diverges from the desired \$1, increasing incentives are applied to either expand or contract the supply).

4.2.4 Releasing Havvens from Escrow

In order to access the original HAV that have been escrowed, the owner must return the same quantity of issued NOM to the system for destruction. This is known as 'burning' the NOM.

4.3 Nomin Demand and Supply

Demand and supply economics shows that there exists some optimal supply of NOM where the related level of demand yields an equilibrium price of $1. We can express this quantity in terms of an optimum utilisation ratio, U_{opt}. The graph below visualises this situation.



Demand

The system is unable to influence the demand for NOM. We assume that some level of demand exists given the utility of NOM as a stable cryptocurrency.

Supply

However where demand is unable to be directly influenced, the supply of NOM is controlled by HAV holders who use the system to issue and burn NOM in response to its incentives. Maximum incentive is achieved when $U_i = U_{opt}$, such that $P_n = 1$. U_{opt} will be discussed further below.

4.4 Fees

Every time a NOM transaction occurs, the Havven system charges a small transaction fee. Transaction fees allow the system to generate revenue, which it can distribute to HAV holders as an incentive to maintain NOM supply at U_{opt}.

4.4.1 Transaction fees

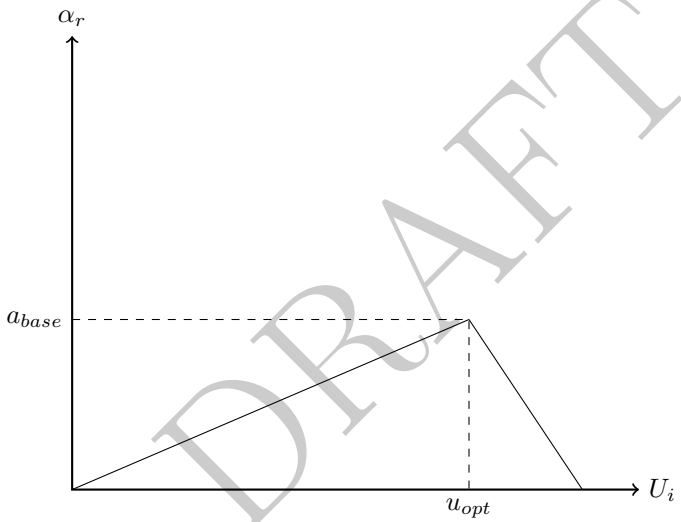
The fee rate charged on NOM transactions is α_c. It is constant and will be sufficiently small that it provides little to no friction for the user.

$$a_c = k.$$

4.4.2 Fee distribution

The fee rate paid to a HAV holder that has escrowed their HAV is α_r. This rate changes with respect the individual's unique utilisation ratio, U_i. It increases linearly to a maximum at the optimal utilisation ratio U_{opt}, before quickly diminishing as U_i approaches U_{max}. Beyond the maximum utilisation ratio α_r is 0. Note, α_r is applied to the pool of collected fees which is determined by α_c.

$$\alpha_r = \begin{cases} \frac{\alpha_{base}}{U_{opt}} * U_i & \text{when } U_i \leq U_{opt}, \\ \frac{\alpha_{base}}{U_{max} - U_{opt}} * (U_i - U_{max}) & \text{when } U_{opt} \leq U_i \leq U_{max}, \\ 0 & \text{otherwise.} \end{cases}$$



This fee distribution curve encourages HAV holders who have escrowed to maintain their U_i at U_{opt}.

We have introduced the concept of an optimal utilisation ratio and its importance in achieving $P_n = 1$. However, the system needs a function to determine what U_{opt} is.

If $P_n > 1$ then the system must encourage more NOM to be issued. If $P_n < 1$, the system must encourage NOM to be burned. The definition of U_{opt} must therefore provide this incentive.

4.5 Utilisation Ratio

4.5.1 Optimal Utilisation Ratio

The optimal utilisation ratio U_{opt} is a target for HAV holders to reach in order to maximise the amount of fees they receive. U_{opt} is defined in terms of P_n such that HAV holders can influence the price of NOM through directly controlling the supply of NOM (a havven holder can change their individual utilisation ratio by buying or issuing more nomins).

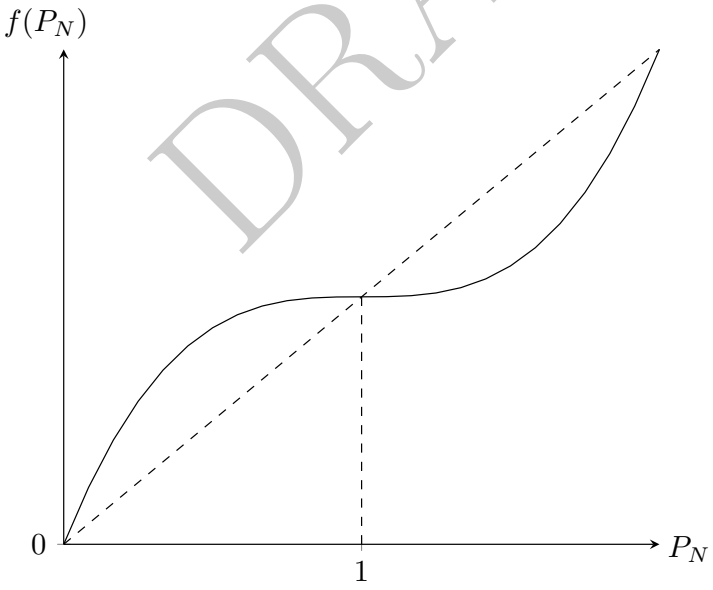
The function for U_{opt} given below provides our dynamic target for HAV holders based on the price of NOM. The curve shows that the when P_n is close to \$1, $f'(P_n)$ is small. However, the further P_n diverges from \$1, the larger the derivative becomes, providing an increasing incentive (via fees) for a havven holder to move toward U_{opt}.

$$U_{opt} = f(P_n) * U,$$

$$f(P_N) = max(\sigma * (x-1)^{\phi} + 1, 0),$$

$$\text{where } 0 \leq \sigma, \text{ the price sensitivity parameter,}$$

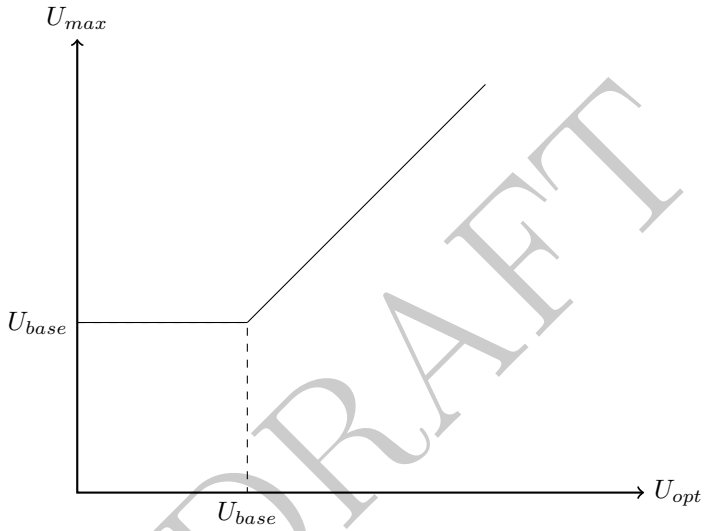
$$\phi \geq 1, \text{ the flattening parameter.}$$



4.6 Maximum Utilisation Ratio

Havven seeks to maintain $U < U_{max} < 1$, in order to remain overcollateralised. It might seem intuitive that U_{max} should be a static value. However, since U_{opt} changes linearly with P_n and inversely with P_h, there are several situations where U_{max} may need to change. Below we define U_{max}.

$$U_{max} = \begin{cases} U_{base} & \text{when } U_{opt} \leq U_{base}, \\ a * U_{opt} & \text{otherwise.} \end{cases}$$



4.7 Intrinsic Havven Price

With the HAV token being ERC20 compliant, it will have a market price on both decentralised and centralised exchanges.

While the Havven system will access the current market price via a price oracle, it is beneficial to define a P_h that can be determined internally to avoiding the influence of speculation. Ignoring speculative demand, P_h can be expressed as a function of the transaction fees that the system charges. Below we define an initial iteration of the intrinsic P_h.

$$P_{h,t} = \frac{1}{H} * \sum_{t=1}^{\infty} \frac{d_{n,t} * v_{n,t} * \alpha_{R,t}}{(1+R)^t} \approx \frac{d_{n,t} * v_{n,t} * \alpha_{R,t}}{R * H},$$

$P_{h,t}$ is the price of one HAV at time t,
H is the number of havvens,
$d_{n,t}$ is the demand for NOM at t,
$v_{n,t}$ is the velocity of NOM at t,
$\alpha_{R,t}$ is the fee from trade with NOM,
R is the interest rate / rate of return of havvens.

4.8 Example Use Case

The issuance concept is best understood using an example:

1. Bob purchases 10 HAV at $10 each, total value $100.
2. The maximum utilisation ratio is 0.2.
3. Bob decides to escrow all of his HAV, equivalent to 20 NOM. These HAV are now not able to be traded.
4. The system sells 20 NOM on the market and transfers the proceeds, in ETH, to Bob's wallet.
5. Bob is free to use the ETH in his wallet in any way, including retaining it for the future purchase of NOM.
6. In order to release the escrowed HAV, the same number of NOM (20) must be returned to the system, even if they have changed in value to say $21 or $19.

Some questions may have already arisen in the reader's mind:

1. Does Bob have to lock all of his HAV *into escrow?*

There is no requirement for Bob to escrow all of his HAV; he can escrow as many as he likes. The quantity of NOM that is sold on the market is $P_h * H_e * U_{max}$ where H_e indicates the quantity of HAV that was escrowed.

2. What if Bob would like to release his HAV*? Where would he acquire* NOM*?*

He simply needs to purchase them in the open market. Assuming an implementation on Ethereum, HAV and NOM would both be ERC20-compatible tokens able to be traded on a variety of centralised and decentralised exchanges. Once Bob buys 20 NOM, he can present them to the system to be burned, thus releasing the escrowed HAV back to him.

3. What happens if the price of HAV *changes?*

All issuance of NOM is done at the current P_h. However, when P_h changes, the quantity of escrowed HAV changes with it (not the *value*). An increase in P_h means that fewer of Bob's HAV are escrowed. By contrast, a decrease in the P_h means that more of his HAV are escrowed. This process occurs automatically in order to ensure that the system remains overcollateralised.

4. What happens if the price of NOM *changes?*

In order to release escrowed HAV, Bob must return the same quantity of NOM that he issued. This means that if P_n has increased in the market, he will need

to spend more ether than he received when he issued in order to release his HAV. Conversely, if P_n has decreased, Bob will need to spend less in order to release his HAV.

4.8.1 Havven Wallet

add diagram of wallet balances.

5 Quantitative System Analysis

We take the view that falsification is an important aspect of validating the Havven system. In our quantitative analysis we seek to identify failure modes of the system, and also to characterise not just *whether* Havven stabilises nomin prices, but *how much* it does.

5.1 Game-theoretic modelling

Discuss the structure of the game Havven represents, incorporating information the economists produce.

Discuss game theoretic modelling.

5.1.1 Actor Definitions

Havven Holder *An investor who owns* HAV *tokens.*

In order to purchase HAV the expected return has to be greater than that of alternative investments (opportunity cost). The expected return of HAV comes from:

1. The fees received on escrowed HAV.
2. An increase in P_h.
3. Seigniorage (i.e., an increment in P_h implies that the investor can issue more NOM, which may eventually have a larger value than his original investment.

At any moment in time, the investor must decide:

1. Whether or not to issue new NOM (assuming $U_i < U_{max}$), or to burn some of them. All NOM are issued/burnt at the prevailing market exchange rate, denominated in ETH.
2. Whether to sell some quantity of HAV in the market at price $P^M_{h,t}$. Only HAV which haven't been escrowed can be sold. Otherwise they must burn NOM to release them.

Nomin User *A person who uses the* NOM *token.*

In order to purchase NOM, it must provide the user more utility than USD, since both have the same consumption value in the market. This utility may come from the properties of crypto.

At any time, they must decide:

1. Whether to buy or to sell NOM at P_n.

Agent-based modelling It has been observed that analytic methods are often difficult to apply in the complex and dynamic setting of a market. One suggested solution to this problem is *agent-based modelling*. Under this paradigm, we proceed by first defining rational agent behaviour and then simulating the interplay of those strategies over time. We seek to develop a more effective method of characterising market behaviour and equilibrium prices than pure analytic reasoning.[?]

Such simulations also provide an immediate means of measuring quantities of interest. Simply by observing the model, we can discover how varying input parameters affect system outputs in an experimental fashion. One important corollary is that this is a way of extracting reasonable settings for system parameters (such as fee levels) that might be difficult to reason about *a priori*. These systems, reactive as they are, also provide a method for testing proposed remedies for any identified failure modes.

Discuss that the game theory conclusions can be simulated

In sum, then, the modelling seeks to answer the following, among other questions:

- Does the system stabilise its nomin price?
- Under what conditions can stability fail?
- What are reasonable initial settings for fees and other parameters?
- What effect does the utilisation ratio have on havven/nomin price ratio?
- What is an effective utilisation ratio?
- What is the effect of a direct redemption regime?
- What are the expected returns for havven-holders?

Fuller description of the technicals of the modelling.

Please visit `research.havven.io` for a pre-alpha version of our model.

5.2 Fee/velocity/return computations

Fee/velocity/return computations

6 Qualitative System Analysis

This section provides a qualitative treatment of the reaction of the Havven system in response to various scenarios listed below:

Scenario analysis.

6.1 Incentives

Why would anyone use nomins?

- Versus havvens?
- Versus alternatives?

Why would anyone issue nomins?

- Fees
- Because they thought the peg would break in the positive direction.

6.2 Scenarios

6.2.1 Havvens appreciate against nomins.

- Havven-holders can issue more nomins.

  This might be scary because we either want the nomin supply to fall, or nomin demand to increase. This is fine if the nomin price fell, because then nomin demand should increase. However, if it was simply that the havven price increased, then this might encourage oversupply of nomins as issuers compete for shares of the fee pool.

- Cheaper exit

  Anyone who has previously issued havvens but who wants to exit can buy nomins for cheaper than they issued them at, so egress with a profit. Alternatively, if the havven price doubles, then only half of their stake is required to back the nomins they have issued. They can use these proceeds to completely liquidate their position.

- Each nomin locks fewer havvens.

6.2.2 Havvens depreciate against nomins.

- Havven-holders can issue fewer nomins.

  Perhaps they may even be under-staked.

- Each nomin locks more havvens.

- A player can issue a quantity of nomins and sell them for havvens.

  They would do this on the assumption that, once the nomin price decreases as a result of the increased supply, they will be able to buy back the same quantity of nomins to free up their havvens more cheaply.

6.2.3 Nomin/havven liquidity dries up

- Low nomin supply

  Nomins should appreciate against the havven. See §6.2.2. Fee takings will decrease, hurting havven-holders in the long run, which should incentivise them to inject nomins into the ecosystem.

- Low havven supply

  If system backers are sitting on a pile of havvens, then the havven should appreciate. See sections 6.2.1 and 6.2.4.

6.2.4 Long-run havven price appreciation

Long-run havven appreciation scenario.

In this instance, over the long run, the price of havvens could appreciate quite substantially, which will lead to an increase in nomin issuance rights (and so probably actual nomins in circulation). There are at least two reasons that havvens could appreciate:

- Increased nomin velocity/demand, leading to greater fees; This is fine: in this case, nomin issuance rights increase in proportion with demand for the currency.

- Speculation This is not so fine: in this case, the nomin supply can be expanded without any accompanying expansion in its demand, which will depress the nomin price.

  Resolve disconnect between speculation-driven value of havvens and nomin supply.

6.2.5 Long-run havven price depreciation

Long-run havven depreciation scenario.

6.2.6 Radical shifts in usage

Usage-shift scenario.

6.3 Expected Market Players

List expected players in the market.

Outline incentives and actions for different players.

- Havven Holders

  A havven-holder provides collateral and liquidity. It's assumed havven-holders seek fee revenues, escrowing as many havvens as they can. This incentive only really makes sense if havvens are not significantly volatile over the long run. But in an unstable regime we also provide incentives for stabilising the nomin price.

- Nomin Users

  Merchants, consumers, service providers, and so on; people who use the stable coin as a medium of exchange. They provide a base demand for nomins, which is necessary for fees to exist. These users may be disincentivised from using the system by excessive volatility in the price of nomins, or by high fees.

- Arbitrageurs, Market Makers

  The arbitrage force allows us to assume that the cur/nom, cur/fiat, nom/fiat prices are properly in alignment or will soon become aligned. Market making activities allow us to neglect the bid/ask spread, and situations where there is insufficient liquidity for players to transact.

- Speculators

  May tend to magnify price corrections, and are a significant vector by which to introduce exogenous shocks to the system modelling, e.g. large capital flows in response to breaking news.

- Malicious Attackers

  We should examine what happens if a George Soros (or otherwise) attacks Havven.

  List the various possible attacks against the system.

- Central Banker

  The Havven foundation will have significant capital reserves with which it could intervene in the market if necessary to stabilise nomin prices. The system should work without such actions, but in extreme situations it might be necessary to undertake them. The advantage of such a market participant is, given that a very large market entity is willing to underwrite the stability of the coin, profit strategies predicated upon the stability of the token become less risky, so more feasible. So the Havven foundation in this capacity takes on the role of providing confidence.

Appendices

A Alternative approaches

Establish a summary of arguments against each competitor

A.1 Basecoin

Description of system Basecoin is described as operating similarly to Havven in that there is separation between a backing token and a transactional token, however Basecoin also separates out a specific "bond" token. The peg to an arbitrary external asset is maintained by using an oracle service to discover the price on an external market, before regulating the supply of "basecoins" through actively increasing (issuing new basecoin), and decreasing (auctioning of bonds) the supply, effectively acting as an autonomous central bank.

A.1.1 Key issues

Basecoin is intended to operate "as a decentralized, protocol-enforced algorithm, without the need for direct human judgment (sic). For this reason, Basecoin can be understood as implementing an algorithmic central bank." Whilst not without merit, this approach was discarded by Havven due to the high degree of design complexity required to be anticipated in order to ensure the stabilisation mechanism is effective. The paper states that Monte Carlo simulations have been run which indicate stability under a range of scenarios, however details are yet to be released by the team.

Another element not explored in the Basecoin whitepaper is the incentives for participants to engage with the cryptoeconomic system itself. While there is no argument against the utility of stablecoins, there must be incentives inherent in all such systems to ensure the appropriate participation of all actors. In this case, there are consumers of the stablecoin and active participants in the monetary policy. It is critical to be able to demonstrate that the incentives within the system will ensure profitable participation strategies for actors. Without this being clarified it is unclear as to whether there will be uptake by enough users to generate sufficient currency in circulation to support the demand for a stablecoin. Critically, the removal of Basecoin from the system to ensure the stable peg is predicated on the significant assumption that participants will take positions in the ongoing bond auctions. This assumption remains untested.

A final point needs to be made with respect to the overarching monetary approach espoused in the whitepaper. In the section "Averting Macroeconomic Depressions" the authors appear to support money printing and inflationary policies and the subsequent devaluation of currency. Even were it possible to demonstrate that inflation of the money supply via such a system would be effective in

combating a deflationary spiral, a far better argument could be made that simply by implementing a stable store of value and unit of account that such a system would not be required. Generally, the apparent assumption that such a system would be achievable and still able to handle monetary crises in a far future time without centralised intervention stretches credulity. It's not entirely clear why Basecoin has intended to merely replicate the function of a central bank, rather than aim for pure stability or a relative-stable approach such as Havven. We are skeptical of any group that would advocate for monetary approaches that are diametrically opposed to cryptoeconomic efforts to democratise money, and we feel that the proposal to intentionally create a systematically inflationary monetary system is not the answer. Instead, we should at this point in time be aiming to construct a system that provides a stable store of value relative to an arbitrary fiat currency. The macroeconomic benefits of such a system are clear, and for as long as we live in a fiat-dominated world this will continue to be the case.

A.2 Tether

Description of system Tether accepts fiat deposits into the Hong Kong-based Tether Limited bank account and issues "USDT" (USD Tether) over Bitcoin via the Omni Layer protocol. Tethers are an asset-backed digital token, representing a claim on the cash held in reserve.

The stability of the USDT 'coin' effectively relies on the force of external market arbitrage to ensure the peg holds over time.

Key issues Despite the whitepaper claiming that the "goal of any successful cryptocurrency is to completely eliminate the requirement for trust," and that each Tether is "fully redeemable/exchangeable any time for the underlying fiat currency," the company's terms of service quite clearly state that "there is no contractual right or other right or legal claim against us to redeem or exchange your Tethers for money."

Tether clearly relies on a manual, centralised proof of existence for the backing asset, and so suffers from the very issue that the Tether whitepaper decries. Indeed the same issue is encountered with tokenised gold, or similarly any other real-world asset where some Oracle bridge is required to interface into a distributed ledger.

Current state Recently, Tether announced support for issuing ERC-20 compatible tokens on Ethereum as opposed to releasing "tethers" on the Bitcoin blockchain using the Omni Layer protocol.

At the time of writing, the market capitalisation for USDT was approximately $440m, and the discrepancy regarding their terms of service remains unresolved.

A.3 MakerDAO

Description of system MakerDAO allows users to escrow collateral to generate a stablecoin, known as the Dai, similar to Havvens escrow system. However, in Havven the collateral is derived from the system itself, whereas in MakerDAO any ERC20 token can be used to generate Dai. The tokens are locked into a smart contract known as a collateralised debt position (CDP). CDPs have multiple risk parameters which are set by the holders of the MKR token. In this way, governance is not directly linked to the capital that backs the Dai.

A.3.1 Key issues

Allowing the system to be collateralised by a range of ERC20 tokens introduces significant complexity because the system must react to changes in many types of collateral. MKR token holders vote to set the risk parameters of each type of collateral. This raises the question, how can the market be confident that the Maker holders are capable of deciding these values correctly? The system incentivises the holders to vote responsibly, but this does not provide confidence that the MKR holders possess the required knowledge.

The collateral in a CDP is always some form of ERC20 token, initially only Eth. This means MakerDAO can never eliminate the systematic risk of the price of Eth and the other ERC20 tokens are used in CDPs. We acknowledge that this approach makes the system less susceptible to price shocks initially.

Current state

A.4 Nubits

Description of system

Key issues

Current state Makerdao critique.

B System variables

More complete system variable section.

What follows are the main variables of the system. Under each heading, each row will correspond to a single quantity of interest. Each row will have three columns. Leftmost, a mathematical definition of the variable; in the middle, the dimension of the quantity (which units it is measured in); and on the rightmost, a short English summary of the variable.

Certain abbreviations will be used. For example, HAV and NOM will be used as abbreviations for havvens and nomins considered as units of measurement.

Prices

P_h	$(\frac{\$}{\text{HAV}})$	: havven price.
P_n	$(\frac{\$}{\text{NOM}})$	: nomin price.
$\pi := \frac{P_h}{P_n}$	$(\frac{\text{NOM}}{\text{HAV}})$	: havven to nomin conversion factor.
$P_h' = f(V_n, V_h) \cdot R$	$(\frac{\$}{\text{NOM} \cdot \text{sec}})$	: havven price rate of change.

Here R is a risk term incorporating, for example, volatility, number of buyers versus sellers, and so on.

Money Supply

H	(HAV)	: Quantity of havvens, which is constant.
H_e	(HAV)	: Quantity of escrowed havvens.
$N = H_N \cdot \pi$	(NOM)	: Quantity of nomins. This can float.
$H_N = \frac{N}{\pi}$	(HAV)	: Havven value of issued nomins.

Ideally, $H_N \leq H_e$.

Utilisation Ratios

$U = \frac{H_N}{H}$	(dimensionless)	: Empirical issuance ratio.
U_{max}	(dimensionless)	: Targeted issuance ratio ceiling.

$0 \leq U \leq U_{max} \leq 1$

Microeconomic Variables These should be defined as functions of P_n, P_v, fees, etc.

S_n	$(\frac{1}{\text{sec}})$	: average nomin spend rate
S_i	$(\frac{1}{\text{sec}})$	: average issuance rate
S_r	$(\frac{1}{\text{sec}})$	: average redemption rate

Money Movement

$V_n = S_n \cdot N$	$(\frac{\text{NOM}}{\text{sec}})$	: nomin transfer rate.
$V_v = V_i + V_r$	$(\frac{\text{HAV}}{\text{sec}})$	: nomin $\leftrightarrow$ havven conversion rate.
$V_i = (C - C_N) \cdot S_i$	$(\frac{\text{HAV}}{\text{sec}})$	: nomin issuance rate.
$V_r = C_N \cdot S_r$	$(\frac{\text{HAV}}{\text{sec}})$	: havven redemption rate.

V_i is assumed to grow as there are more free havvens in the system.

V_r, by contrast, is taken to grow proportionally with the number of escrowed havvens.

Fees

The following fees are ratios, for example 0.1%, levied on each transaction.

F_{nx}	(dimensionless)	: nomin transfer fee
F_{cx}	(dimensionless)	: havven transfer fee
F_i	(dimensionless)	: nomin issuance fee
F_r	(dimensionless)	: havven redemption fee