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COGITO

A decentralized and AI-driven stable asset

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ABSTRACT

Cogito Protocol offers a “stablecoin-as-service” framework to create digital assets with low volatility called “tracercoins” such that they act as complements to existing crypto landscapes. The tracercoins maintain their stability not by seeking explicit correlation to one or more specific fiat currencies or commodities, but instead via soft-pegging to non-financial indices that represent progress along various developmental fronts, e.g. environmental progress, technological progress etc. The indices are constructed from a large series of macro data, which are strongly resistant to manipulation, fluctuate moderately, and reflect the genuine progress of humanity. Since manipulating the value of these indicators would require Herculean resources and efforts, these tracercoins can provide fair and independent measures of value, which in a fundamental sense are more effective than any available alternatives.

Initially, a Green Coin (or GCOIN) will be launched to trace a green index that measures the positive progress towards a net-zero economy. GCOIN can be considered a new form of stablecoins, which is designed for low volatility and is independent from fiat currencies. The GCOIN, along with future coins in the Cogito tracercoin family, will be regulated by the native ecosystem token: the CGV token, which is used for both governance and supporting the algorithmic stabilization mechanisms.

The Cogito Protocol aims to develop different products for usage across decentralized finance (DeFi) and conventional businesses. Different Cogito tokens may have different quantitative and qualitative properties but there will also be a common set of features. Users will always be able to trade the tracercoins within specific boundary values (the indices' boundaries). Classic cryptocurrency use-cases such as storage of value and payments can be more effectively fulfilled by Cogito tracercoins than by traditional cryptocurrencies, with their excessive volatility, or by traditional stablecoins with their frustrating and unnecessary fiat dependency.

While algorithmic stabilization methods (both AI based and traditional) are key to Cogito's operation, they will not be relied on exclusively. A risk-weighted reserve will back the protocol to ensure that the stable assets can be redeemed under all circumstances, thus avoiding many of the problems associated with pure algorithmic stabilization. The reserve will contain both liquid and illiquid components and will be managed by Cogito's Algorithmic Stabilization Protocol (ASP) through a mix of AI techniques defined by the Autonomous Stabilization Functions (ASF). The programmed rules adjust the risk-weighted reserve and update minting and burning parameters and other mechanisms to make sure the reserve is sufficient to stabilize the tracercoins.

Introduction

Bitcoin and many of the early altcoins were created with a view toward providing individuals and entities with a reliable store of value and payment mechanism that is not reliant on fiat currencies. The underlying motive was that value storage and payment should be carried out via a network collectively owned and controlled by all the participants, rather than by a centralized authority like a nation's central bank or a global tech corporation.

In practice, Bitcoin and other cryptocurrencies have proven too volatile to serve as a primary store of value for many; though up until now they did have value as investment assets that gave strong returns which were relatively uncorrelated to mainstream economic indicators. Cryptocurrencies, so far, have also proven both too volatile and too expensive to replace fiat currency for most practical financial transactions.

Stablecoins emerged as a partial solution to these problems, reining in volatility by pegging their values to fiat currencies. However, this renders their value directly susceptible to manipulation by central banks and associated corporate interests, somewhat obviating the point of having independent digital assets in the first place. Governance of the major stablecoins has also been highly centralized in nature, leading even further away from the initial democratic ethos of the crypto space.

Cogito is introducing the first algorithmic digital assets designed to achieve relative stability without introducing direct dependence on fiat currencies, commodities, or other traditional financial instruments. Rather, they are designed to increase in value smoothly and steadily with the progress of humanity, by soft-pegging to non-financial indices that quantify aspects of global human development, such as environmental progress and technological growth. This approach to managing the stability/volatility tradeoff without explicit reference to fiat currencies allows some of the long-term goals of crypto-finance to be achieved far easier than before. Cogito's mechanisms solve the problem of creating tokens providing long-term value-storage with manageable volatility, as well as the problem of providing a steady and reliable payments token for both micropayments and larger transactions.

Each Cogito tracercoin is backed by a reserve comprising a variety of assets appropriate to the underlying index to which the asset is soft-pegged. Additional stabilization is provided by algorithmically driven methods, including traditional techniques familiar from fiat-based stablecoins, and more innovative variations that incorporate AI predictive analytics and reinforcement learning.

Cogito's algorithmic protocol ensures that its tokens can be continuously traded within specified trading boundaries, and that they can always be minted or redeemed from the protocol for a target value. These properties allow arbitrageurs to balance the demand and supply of tokens and let the price dynamically reach an equilibrium. The assets contributed by users are managed judiciously as two components: liquid and illiquid assets. Liquid assets are primarily fiat-pegged stablecoins such as USDC or DAI, and illiquid assets are investments that are less readily available to users in case of liquidation. These components represent the primary sources of the protocol's liquidity. For a period immediately after launch, this reserve will consist of a basket of stablecoins; then, when the project builds up the reserve to a satisfactory high level, more volatile assets will slowly be introduced.

The protocol will initially adopt Uniswap v2's Automated Market Maker (AMM) that is widely used by many decentralized exchanges (DEXs) in DeFi. This makes liquidity available at all times and enables ASFs to dynamically adjust liquidity and bring the market price back within the desired bounds. Holders are able to sell back tracercoins to the protocol at any time.

Cogito tracercoins can be used for a variety of derivative financial instruments. For instance, users will also be able to obtain a variable yield by depositing into the protocol. This rate will be determined by market conditions and the tenor of the deposit.

The protocol charges two different fees, which together comprise the core mechanism providing revenues to ongoing treasury improvements and evolutions of the protocol. The first fee derives from the minting of tracercoins (origination transaction costs), which is a fixed percentage of the minting amount. The second is the redemption of the tokens (redemption fee) in the form of slippage from the AMM price curve.

1.1. An overview of stablecoins

Since the establishment of Bitcoin, a handful of different types of stable cryptocurrencies have been created, mostly designed to track fiat currencies like USD or other major commodities. These are generally backed by fiat and crypto assets – and in the latter case, the crypto-asset backing mechanisms have varied greatly in sophistication and reliability. The role of stablecoins has risen dramatically with the advent of DeFi, as much DeFi activity relies on having some relatively stable crypto-asset to use as a reserve token and as an intermediary between other crypto-financial products.

Conceptually, a stablecoin is a digital token that has low price volatility over time. So far this stability has generally been achieved as a result of being pegged to some underlying fiat currency, but this is not the only logical way to do things. More broadly, the “stability” of a token may be understood as relatively low variance over time in the number of tokens needed to purchase some standardized basket of goods and services (e.g. a pound of carrots, a rack of ribs, 1GB of 4G mobile internet minutes, a tank of gasoline, etc.). Fiat currencies are not intrinsically stable in this sense, though the fiat currencies associated with major national powers have been relatively stable in the recent past.

Cogito’s tracercoins achieve their stability via soft-pegging to non-financial indices that are not directly tied to fiat currencies or other standard financial instruments or commodities. However, they still share many features in common with conventional stablecoins. Although there are numerous technical differences among existing stablecoins, we can characterize them in general based on the following attributes: I) the peg, II) the collateral, which can be fiat currencies such as USD or a basket of different currencies, crypto assets, and commodities, and III) the ratio of backing collateral to outstanding supply, which can be “none”, “partial”, “full”, or greater than 100% (ie. overcollateralized).

Several popular stablecoins mimic the value of the US Dollar (USD) by using it as collateral and then tokenizing associated funds. This design – an issue with many crypto users who believe in the core values of openness, transparency, and decentralization. Scalability also becomes an issue here. The issuer must prepare the same amount of fiat currency as the outstanding stablecoin to ensure that it is always pegged and redeemable for the underlying fiat currency. However, the greater the stablecoin’s scale, the more the issuer must reserve fiat currency, unless their users accept partial reserves.

Other stablecoin designs use cryptocurrencies or commodities as collateral, resulting in more decentralized systems. However, such backing assets can be highly volatile, which is why this type of stablecoin is almost always over-collateralized to avoid fluctuations that can result in insolvency and lead to the peg being broken.

There is a type of stablecoin which has no collateral – so-called “algorithmic stablecoins”, which are managed by automated smart contracts that adjust their supply based on the expectation of the future demand or the growth rate of the ecosystem.

Finally, hybrid stablecoins such as risk-weighted-reserve-backed algorithmic stablecoins have been created that attempt to combine the strengths of both approaches to provide price stability.

1.2. Price stabilization mechanisms

While stablecoins are a relatively new entrant into the financial arena, the core concepts and methods of price stabilization underlying them are familiar from traditional economics. To explain how and why

Cogito's price stabilization methods work, it is valuable to briefly review some of the economics background.

At the most basic level, all methods for stabilizing the exchange rates of currencies rely on a simple supply and demand based economic model. In essence, this sort of model states that a change in the market price (i.e. the exchange rate relative to a given reference currency, commodity, or basket) is due to changes in relative supply and/or demand. Given this assumption, the system can hold the stability around a target price if it counteracts this change, e.g. by buying or selling quantities of currency to impact market properties and behavior. This basic logic applies whether one is looking at fiat currencies, tokens pegged to fiat currencies, or to non-financial indices as with Cogito.

Artificial intelligence algorithms can be helpful here to the extent they can predict changes in supply and/or demand before they happen. In this case, a stabilization system can carry out financial transactions aimed at palliating supply or demand changes when they are in their initial stages, preventing them from becoming too extreme. Modern machine learning and reinforcement learning algorithms can be very powerful here; in this context, Cogito will leverage AI crypto-finance work done in the last two years by SingularityNet and SingularityDAO, using deep neural networks, multi-agent systems, and other methodologies.

These basic economic concepts can be expanded upon in various ways, arriving at a spectrum of theoretical analyses of price stabilization, each of which has its pluses and minuses. Makiko Mita et al[1] discussed and compared several theories on price stabilization mechanisms for decentralized payment systems, including Quantity Theory of Money, Tobin Tax and Speculative Risk. These offer relevant background for understanding the design choices behind Cogito.

Quantity Theory of Money (QTM) is an early economic theory that is concerned with controlling the money supply and stabilizing the price of the currency. In a conventional fixed-exchange-rate regime, a central bank stands ready to use its foreign reserves to exchange for domestic currency if there are persistent deviations from the peg. When the domestic currency's value trades below the peg, the central bank reduces the supply of domestic currency by selling foreign reserves. The stability mechanism is thus supply-driven in the case of a central-bank-managed peg. QTM helps us understand how money moves and how to adjust the money supply. QTM was later updated by Milton Friedman who argues that a central bank policy should aim at keeping the growth of the money supply at a rate commensurate with the growth in productivity. According to Friedman, "The stock of money [should be] increased at a fixed rate year-in and year-out without any variation in the rate of increase to meet cyclical needs" (Friedman, 1960)[2].

[1] What is Stablecoin?: A Survey on Its Mechanism and Potential as Decentralized Payment Systems
Makiko Mita, Kensuke Ito, Shohei Ohsawa, Hideyuki Tanaka
[2] https://en.wikipedia.org/wiki/Friedman%27s_k-percent_rule

Historical data analysis shows that QTM explains practical monetary behavior only in certain contexts and within certain bounds. Statistically, there has not been a strong correlation between changes in money supply and inflation/deflation, either among traditional currencies (Wang, 2017)[3] or cryptocurrencies (Withiam, 2020)[4]. Partly, this has been because other factors such as financial innovation, market sentiment and political dynamics have proved dominant. However, it has also likely been partly because central bankers and their crypto analogues have tended to avoid extremely unwise money supply adjustments due to the warnings posed by QTM theory.

The Tobin tax theory is based on the concept of a tax on international financial transactions designed to control exchange rate volatility. Makiko Mita points out that the Tobin Tax mechanism tells us how to stabilize stablecoin prices by including transaction fees. When users buy or sell a stablecoin and cause the price to deviate from other currencies (eg. USD), a high transaction fee is applied to disincentivize trading. On the other hand, when users buy or sell a stablecoin and cause the price to match other currencies, a low transaction fee is applied and users are incentivized to continue.

Transaction fees can also be utilized to help disincentivize destructive behaviors by bad actors. As Makiko Mita pointed out, as long as a stablecoin is designed to peg to something, it is exposed to the risk of speculative attacks aimed at moving the value away from the peg so as to profit from the necessary efforts to move it back. To mitigate speculative attacks, Spahn[5] proposed a high transaction tax for speculative trading showing hallmarks of a speculative attack. However, he also pointed out that it is “virtually impossible to distinguish between normal liquidity trading and speculative “noise” trading.” Spahn expanded the Tobin tax to “a two-tier rate structure consisting of a low-rate financial transactions tax, plus an exchange surcharge at prohibitive rates as a piggyback. The latter would be dormant in times of normal financial activities and be activated only in the case of speculative attacks”. There is a clear potential role for machine learning here, in accurately identifying patterns of behavior characteristic of the early stages of a speculative attack.

Bank runs are another risk that those managing stablecoins must deal with, in a manner somewhat comparable to traditional fiat banks. Diamond and Dybvig[6] formulate bank runs in terms of game theory, pointing out that a bank run can be a Nash equilibrium because when one user thinks that other users will withdraw their deposits even when they do not need to, the withdrawal makes that one user’s utility increase. To avoid this game theoretic dynamic and prevent bank runs, they fall back to the tried and true mechanism of deposit insurance. Obstfeld[7] adopts a game theory approach to fixed exchange rate currencies that depend on a reserve fund, coming to similar conclusions.

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[3] Wang, Xi (2017). The Quantity Theory of Money: An Empirical and Quantitative Reassessment. https://cpb-us-w2.wpmucdn.com/sites.wustl.edu/dist/3/817/files/2017/09/QTMmainCIA-v3nep6.pdf
[4] Withiam, William (2020). Does the percentage of total tokens staked have an impact on price? https://messari.io/article/does-the-percentage-of-total-tokens-staked-have-an-impact-on-price
[5] Spahn, P. B. (1995). International Financial Flows and Transactions Taxes: Survey and Options. IMF.
[6] Diamond, D. W., & Dybvig, P. H. (1983). Bank Runs, Deposit Insurance, and Liquidity. The University of Chicago Press. The Journal of Political Economy, Vol. 91, No. 3.
[7] Obstfeld, M. (1995). Models of currency crises with self-fulfilling features. European Economic Review 40.

We observe adoption and variants of these economic theories in the design of different stablecoins. With collateralized stablecoins, for instance, there is generally no equivalent of a central bank actively participating in the market to stabilize the peg. Instead, most stablecoin systems generate price stabilization through demand-driven flows to arbitrage differences between the intended peg and the rate in the secondary market. As soon as the price of the stablecoin rises above parity, there is an incentive to deposit fiat currency to mint coins and sell them in the secondary market. The stability mechanism is thus supply-driven in the case of a central-bank-managed peg. This is the elemental design of stablecoins such as USDC and USDT.

With algorithmic stablecoins, we see Ampleforth is theoretically based on the Quantity Theory of Money, whereas Fei adopts the transaction fee theory in its design. Although we have not seen any stablecoin projects following Friedman Theory, one could interpret the downfall of Luna as providing a piece of evidence regarding what happens when Friedman's ideas on money supply are egregiously ignored. Terra/Luna grew to being the largest algorithmic stablecoin, in part due to a practice of over-printing UST stablecoins substantially beyond what any macroeconomic fundamentals would suggest; this, among many other reasons, led to the collapse of the giant.

Cogito's price stabilization model is based on these general economic principles as applied to DeFi ecosystems. Cogito's underlying quantitative-finance algorithms provide a solution to a core question: How can the protocol manage a digital asset that keeps its price stable over the long run and aligns its intrinsic value to the progress of humanity? In what follows, we will explore how this solution works – first introducing the conceptual principles underlying Cogito, then addressing Cogito's detailed architecture, stability mechanisms, and price curve.

2.1. The origins of Cogito

The concept behind Cogito tracercoins is to define cryptocurrencies whose value is tied to the steady progress of humanity along some measurable axes. The further and faster progress occurs, the more each token is worth. Within this framework, Cogito will initially create a GCOIN that is soft pegged within specific trading boundaries (an upper bound and a lower bound) to a green index.

Cogito's tracercoins are not "stablecoins" in the traditional sense of being crypto-assets that purport to maintain a stable value by referring to the value of one fiat currency or a basket of fiat currencies that are legal tender, nor to individual commodities nor baskets thereof. They are "stablecoins" in a broader sense, in that they aim to maintain a measure of value stability by automatically regulating their value over time to track specified non-financial indices. If a non-financial index has low variance and is very slow to increase in value over time (like the index underlying GCOIN), then a tracercoin can track the index closely and maintain stability that way. If a non-financial index increases in value over time in a steady but rapid way, then tracking its value with a tracercoin is still possible, but one must accept a

somewhat greater degree of deviation from the index. This is due to the fundamental principles of risk/return tradeoff.

Tracercoins will be fully backed by appropriate reserves, coordinated by an algorithmic protocol that manages liquidity and collateral contributed by liquidity providers.

These tracercoins are designed to be resistant to hyperinflation due to their low-to-medium volatility and offer economic freedom and a stable growth opportunity to anyone, anywhere. Together with the GCOIN, we will launch a native CGV token that, besides being a governance token, is the main beneficiary of the protocol's revenues.

Over time, Cogito aims to develop different financial products building on its core tracercoins, targeting other users with varying scopes of business. It will start with DeFi users, but it will expand operations into FinTech to let anyone use Cogito for day-to-day payments. Cogito tokens are well-suited for everyday use as stores of value and payments (though rollout for extremely low-cost, high-volume micropayments will likely require some level of custom blockchain infrastructure such as that provided by the Hypercycle sidechain framework[8]). It is also possible for Cogito to issue additional tracercoins based on other non-financial indices, depending on market demand.

2.2. Cogito design and CGV utility

Initially the protocol will only accept stable assets as the reserve, but once the protocol gains traction and the system's money velocity increases, the underlying financial dynamics will gain more subtle mechanics**.** In this phase, the protocol will allow the reserve to accept a cautious portion of more volatile cryptocurrencies, and the capital adequacy ratio (CAR as defined in Section 3.1) will change algorithmically to handle volatility or more exponential expansion (Fig. 1).

[8] Hypercycle.ai

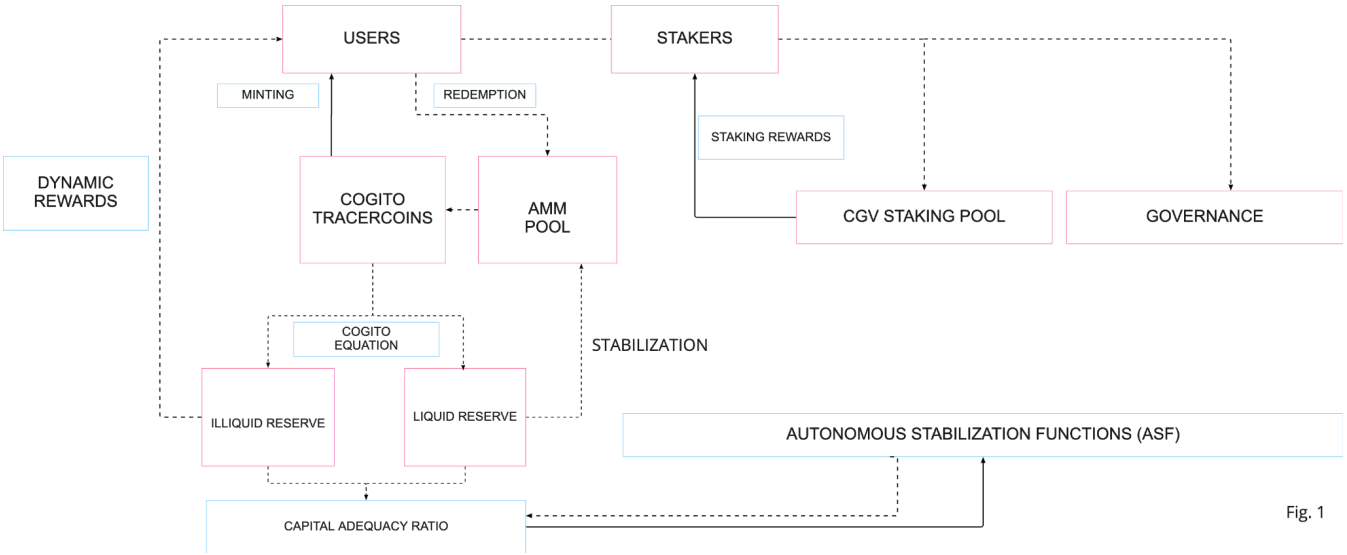


Fig. 1

The protocol aims to avoid the problems associated with pure algorithmic stablecoins by using AI principles and a variable amount of risk-weighted reserve to provide effective stabilization in diverse market conditions.

The CGV governance token will play a key role in regulating the use of these mechanisms, providing a tool for democratic decision-making and for rewards for users, and will also serve as a critical stabilization mechanism of the ecosystem. CGV and the initial tracercoins will be implemented on Cardano as native assets (and likely later ported to the Hypercycle sidechain), but can also be extended to other blockchains with bridges, enabling Cogito to interoperate with all DeFi protocols no matter what underlying blockchain they run on.

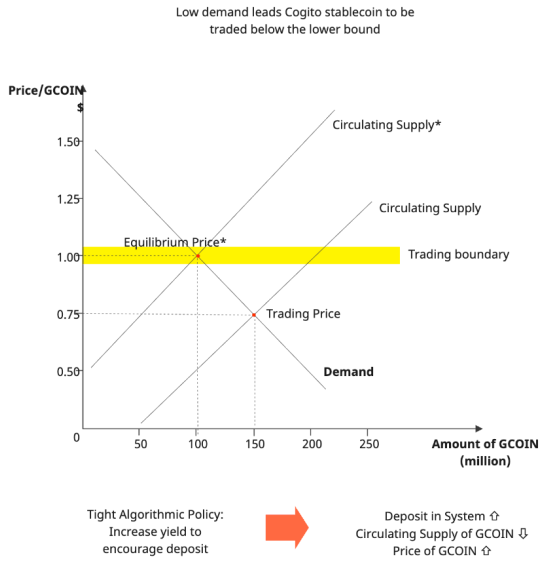
To guide the operation of its tracercoins, and under the supervision of the community of CGV holders, Cogito will operate three main protocols from the start: I) Algorithmic Deposit Protocol (ADP); II) Algorithmic Stabilization Protocol (ASP); and III) Algorithmic Governance Protocol (AGP). All these products will be regulated by a treasury reserve, which is formed by a liquid and illiquid component managed through Autonomous Stabilization Functions (ASFs) – programmed rules that adjust the risk-weighted reserve dynamically and handle the minting and burning rules and other stabilization mechanisms.

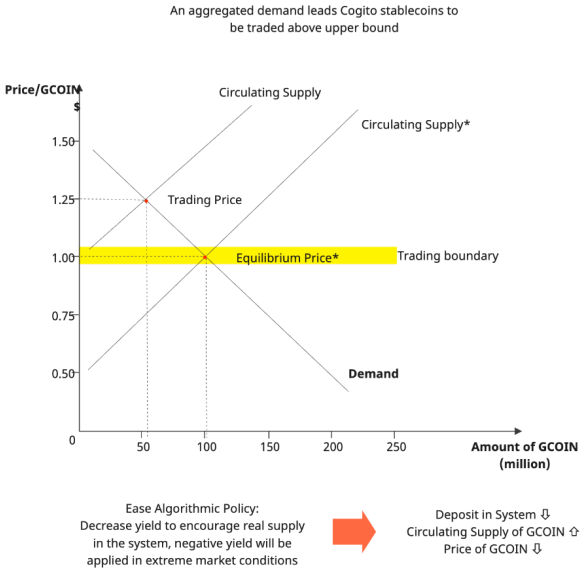
I. Algorithmic Deposit Protocol (ADP)

The goal of the ADP is to let users with different risk appetites deposit their tracercoins with customizable tenors to earn a floating yield, generated from the illiquid reserve that is managed by the treasury. This yield will be distributed both in CGV tokens and stablecoins.

The floating yield is acting as an instrument of algorithmic policy to help stabilize the system. In the case where there is a shortfall of tracercoin supply in the market, the yield will be reduced in order to

discourage deposits, thereby increasing the circulating supply. Similarly, when there is too much supply, the protocol will increase the yield and therefore decrease the circulating supply. AI methods can be used here to predict undersupply or oversupply in advance, such that these situations can be counteracted before they get out of hand and require more effort.





II. Algorithmic Stabilization Protocol (ASP)

The ASP has the critical goal of maintaining the market price of the tracercoins within specific trading boundaries of their respective indices. The algorithmic stabilization functions will adjust the Capital Adequacy Ratio to ensure stability.

Initially, ASP will use Uniswap V2 functions to develop the liquidity pool. This effectively creates an open market that allows tracercoins to be exchanged efficiently. Using this module, we can leverage SingularityNet's and SingularityDAO's powerful trading desks and unique autonomous AI-driven agents to perform price arbitrage in order to maintain the stability of the tracercoins at all times.

The capital that the protocol can utilize and deploy comes from three sources: liquid reserves, loans collateralized by illiquid reserves, and proceeds from selling CGV tokens under extreme market conditions.

- Liquid reserves. A healthy portion of the reserve is kept as liquid assets, which is primarily stablecoins such as USDC, DAI etc.
- Loans collateralized by illiquid reserves. The illiquid component of the reserve is kept as low-to-medium risk assets, either in the form of investment into a basket of cryptocurrencies (e.g. BTC, ADA) or liquidity provided to other protocols for yield optimization. We will obtain a

credit line by collateralizing the assets with the lender to supplement the liquidity, and subsequently the future protocol revenue will be prioritized to repay the debt

- Proceeds from selling CGV tokens. CGV acts as a last resort to absorb the price volatility of tracercoins. A predetermined percentage of CGV from the foundation is set aside to supplement the treasury reserve as an additional buffer to the system.

III. Algorithmic Governance Protocol (AGP)

The final protocol concerns CGV tokens. As with many other protocols, the intrinsic value of the Cogito governance token is positively correlated with tracercoin adoption. If the ecosystem grows and tracercoins are in high demand with a healthy CAR, some percentage of the illiquid reserve can be used to buy back CGV tokens, which aligns incentives among both CGV users and tracercoin users.

Usage of tracercoins will generate revenue for the protocol in three ways: minting fees of tracercoins, DEX arbitrage, and management fees from treasury management. CGV token holders will be able to stake their tokens to earn yield from the staking pool, together with a small percentage of inflationary reward. The revenue can also be used to buy back the CGV to decrease the circulation supply and therefore increase the token's value. This creates a positive benefit for Cogito because as the value of CGV goes up, tracercoins are more able to withstand extreme volatility events.

Finally, the protocol aims to implement the well-known "vote-escrowed model" to create an incentive-aligned decentralized autonomous organization (DAO). It prevents large users with a low long-term conviction from having a disproportionate amount of voting power, as compared to smaller users with a higher degree of confidence in the project. Such a voting system helps to align the interests of users with the long-term development of the protocol.

2.3. The index

Cogito will initially create a green index that is periodically rebalanced to track the progress of positive progress towards net-zero economy, which will be reflected in the fair value of their respective tracercoin.

The index will be constructed as weighted averages of a reasonably large set of quantitative indicators, with data coming from trusted third-party sources such as the World Bank, OECD, United Nations etc, which are free of protocol-level dependencies.

The data covers multiple dimensions, incl. CO2 emission, green investment, adoption of green energy etc. These data are then integrated and aggregated to a weighted average to quantify the progress on improving the environment.

Based on our work doing quantitative modeling and intensive simulation of the data from the past 40 years, we have reasonable confidence that the index should trend upwards at different velocities. Additionally, the nature of the index should ensure that it is reasonably stable without large, sudden changes (except in case of genuinely long-tail events like a world war, an asteroid hitting Earth, or a sudden epochal engineering breakthrough). While some of the constituents of the index will only be measurable, say, quarterly or annually, the algorithm will also include an interpolation and smoothing equation that allows it to have an estimated value each day so that the index's value changes relatively continuously day to day, rather than having a huge jump when new data is released. A global committee of cross-disciplinary experts will be assembled to manage the components and weightings of the constituents of the index each year, and will be subject to community governance for major changes. The construction of the index will have maximum transparency since the data is publicly available and the model is open-source and can be verified at any time.

Finally, one of the most important value-adds of Cogito is that the tracercoins provide an alternative solution to the Oracle problem of blockchains, at least in certain aspects. Our protocol is connected to both on-chain and off-chain networks, so that it can fetch data from one or multiple external sources and bring the data on-chain via the creation and tracking of indices.

3.1. Capital Adequacy Ratio

One of the key characteristics of the protocol is that when users deposit crypto assets and mint tracercoins, the underlying crypto assets are split in two reserves. This split is determined by the Capital Adequacy Ratio (CAR).

The CAR is the core essence of Cogito that provides pragmatic guidance for treasury allocation, risk management, token buyback, and protocol growth. It ensures that capital of the protocol is kept at a level sufficient to absorb losses and counteract negative events, in order to protect users and ensure stability.

As mentioned earlier, the reserve consists of a liquid and illiquid component. We assign a risk discounting factor for each asset based on the associated risks and liquidity. The discounting factors are based on three major risks:

- Counterparty risk associated with stablecoins, i.e. a counterparty (e.g. a farming or a lending protocol) fails to repay the full amount of USDC we've deposited.

- Market risk associated with losses due a decrease in the value of investments. It applies to all trading book products.
- Operational risk resulting from inadequate or failed internal processes, people and systems, or from external events, for example hacking or exploits to our system.

The Cogito team has developed a scorecard system to determine the discounting factors, where metrics include project performance, historical price volatility, track record of security, and other factors. The scorecard will be managed by the Cogito treasury investment board and be updated regularly for public review.

Similarly, the liability of the protocol is assigned a time factor depending on the tenor of deposits placed in the ADP. The CAR is calculated as follows:

$$Capital\ Adequacy\ Ratio\ (CAR) = \frac{Risk\ Weighted\ Capital}{Tenor\ Weighted\ Debt} = \frac{\sum_{i}^{n} A_i * df_i}{\sum_{j}^{m} L_j * tw_j * e} \qquad \text{Equation 1}$$

A_i is the market value of asset i in the reserve

df_i is the respective discounting factor for asset i

L_j is the amount of tracercoins outstanding

tw_j is the time weighting factor of a given tracercoin

e is the exchange rate of the tracercoin to stablecoins

As an illustration, assume the reserve includes a liquid reserve of 100 USDC, an illiquid reserve of 100 USDC deposit in a credited platform (e.g. AAVE) for 6 months, and an illiquid reserve of BTC with a market value of 100 USDC. On the other hand, outstanding tracercoin is 300 GCOIN, of which 100 in users' wallets, 200 in ADP for 12 months. GCOIN price is 1.02 USDC.

We establish that liquid reserves have a 100% discounting factor, meaning we don't discount it at all. Medium term investments ($6\,months \leq Tenor < 12\,months$) have a 95% discounting factor and blue-chip risky assets have a 60% discounting factor. Meanwhile, liabilities with 1 year tenor carry a time factor of 88%, i.e. we discount it by 12%, which is the Time Value of Money (TVM)[9] indicating the current value of future cash flows.

Liquid Reserve - USDC	100 * 100% = 100
Illiquid reserve - USDC deposit for 6 months	100 * 95% = 95
Illiquid reserve - BTC	100 * 60% = 60

[9] https://en.wikipedia.org/wiki/Time_value_of_money

GCOIN in users wallet	100 * 100% = 100
GCOIN deposited for 12 months	200 * 88% = 176
Total Risk Weighted Asset (USDC)	100 + 95 + 60 = 255
Total Tenor Weighted Liability (USDC)	(100 + 176) * 1.02 = 281.5
CAR	255 / 281.5 = 90.6%

CAR directly impacts the risk tolerance and investment decisions of the protocol. The ASF monitors the CAR continuously and adjusts strategies through what we call a “defensive mechanism” to ensure the CAR is kept at a satisfactory level.

During the full collateralization phase, the CAR is expected to be running between 90% to 110%. When the CAR is much higher (>110%), the ASF will allocate more reserves to illiquid components, and invest in higher risk protocols or assets to generate higher yields. When the CAR drops below 90%, the program will be more risk-off and invest in safer products; in the meantime, the protocol will divert the ongoing revenue to liquid reserves to supplement capital. If the CAR drops further to below 75%, the protocol will halt interest distribution and build up reserves until the CAR recovers. In drastic scenarios where the CAR drops below 50% — even though this may not warrant a depeg or failure of the tracercoins — we will trigger the distribution of retained profits or sell off reserves to defend the CAR. When the system is running as a risk-weighted-reserve, we aim to achieve a CAR ratio of at least 75%, which is the safety ratio to prevent substantial bank runs in most of our stress tests. This is much more prudent than traditional banks where regulation requires the banks’ CAR (which is defined similarly as our approach) to be only a minimum of 8%!

3.2. The ADP and reserve management

The Algorithmic Deposit Protocol (ADP) is created with the ultimate goal of providing passive income to users whose interest is aligned with the long-term vision of the project. This reward is represented by an annual percentage yield (APY) in the form of both stablecoins and CGV tokens (figure 2). The reward is achieved by diversifying the illiquid reserve into different investment options with varying risks and volatility, e.g. deposit pools, proof-of-stake rewards, business-to-business lending, yield farming pools, and direct investment in volatile assets, in order to generate realistic and sustainable returns. The rate depends on the tenors deposited into the ADP and long-term deposits are incentivized with higher yields, in a non-linear manner.

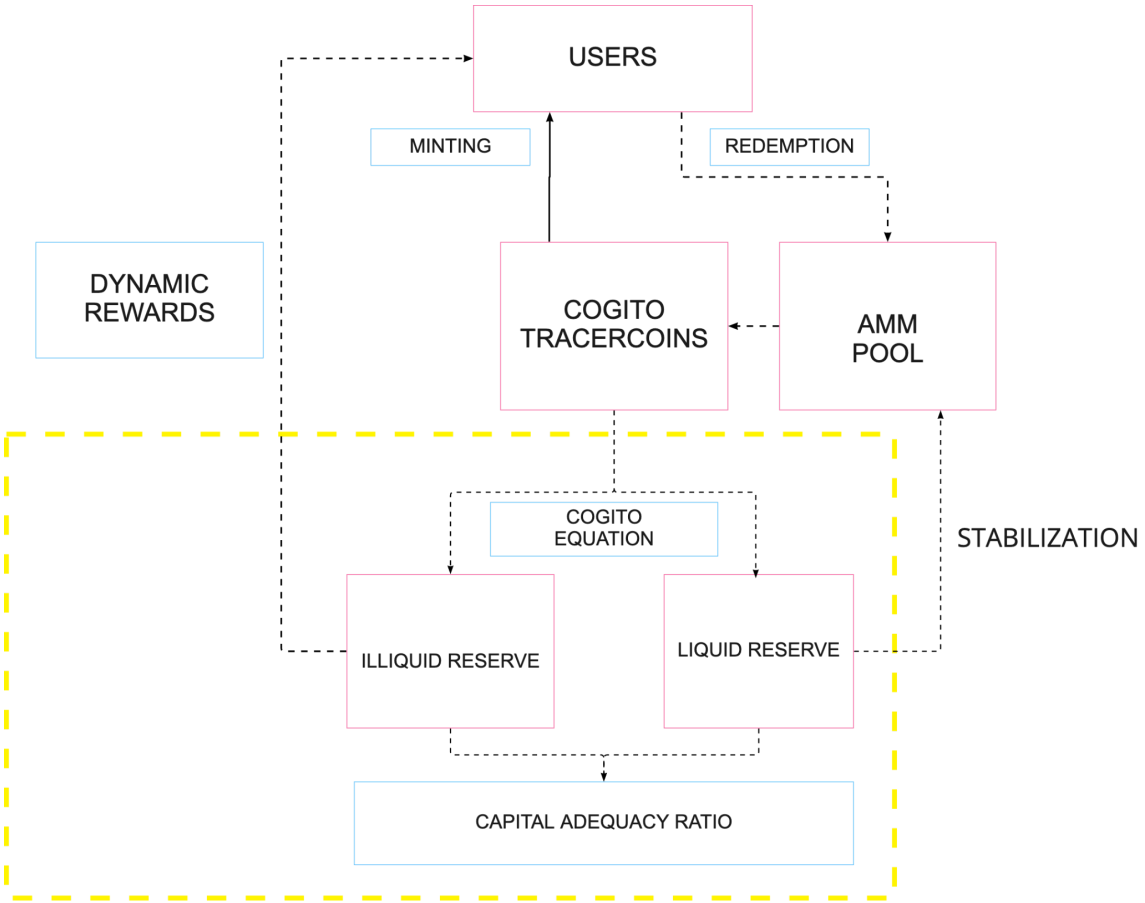


Fig 2. Algorithmic Deposit Protocol (ADP)

3.2.1 Cogito equations

The swapping between two reserves that lie at the core of the protocol is based on the risk-weighted ratio that the project is running at the given time t , as defined by the following equations:

$$x + y = A * (1 - c); \qquad Equation\ 2.1$$

$$\sum_{i=1}^{n} y_i df_i + x = A * (1 - c) * CAR; \qquad Equation\ 2.2$$

where:

A: user deposits, measured in USDC

c: transaction cost in percentage

x: liquid reserve, where $x \geq 0$

y: illiquid reserve to be allocated to n different risky assets, we have $y = \sum_{i=1}^{n} y_i \,\&\, y_i \geq 0$

df_i : discounting factor of risky asset y_i

These equations provide a guiding framework for reserve allocations. Ultimately, other factors will need to be taken into account, such as market sentiment and liquidity, to maximize the returns from the investment.

As an illustration, assume Cogito is running at a minimum of 90% CAR. Alice deposits 101 USDC to mint the tracercoin, and the minting fee is 1%, i.e. 100 USDC will go to the reserve after subtracting the transaction fees. The liquid reserve consists of USDC and the illiquid reserve consists of 2 risky assets: a 6-month USDC deposit with a discounting factor of 95%, and BTC with 60%.

Solving the equations 2.1 and 2.2, we know that for the 101 USDC deposited, the algorithms are allowed to allocate anywhere between 14.3 to 25 USDC to BTC (detailed calculations are available in our github, and we will skip here for simplicity). Considering that the cryptocurrency market has an apparent cycle where it grows and retracts, which significantly impacts users' appetite for holding low-volatility coins, this range allows the protocol to have more flexibility to adjust investment strategies. In a rising market, the project can be more risky and invest in riskier assets, and therefore can allocate all 25 USDC to BTC; in a sluggish market the protocol is more likely to be risk-off and hold less risky assets, and only likely to invest 14.3 USDC in BTC.

3.2.2 Investment risk management

When it comes to reserve investment, there is always a non-zero chance of counterparty risk - DeFi protocols could be hacked or exploited and cause loss of funds; CeFi protocols could be insolvent and pause user withdrawals, or worse, the platform is fraudulent and steals user funds. The treasury investment board, which can be formed and governed by the DAO, will build a risk rating system, assess and recommend a risk classification for the platform, and we will invest our illiquid reserve according to the risk guidance of such platforms.

In our work on the Cogito protocol, we have modeled the quality of platforms with the concept of *probability of default*. While there is no readily available data regarding the probability of default for DeFi and CeFi platforms, we take reference from Moody's ratings where they classify entities as investment grade and speculative grade. Cogito Protocol will always invest in projects with manageable levels of risk that are at least comparable to a Moody's 'B' rating. The investment board will be responsible to identify the partners and assess the associated risks, and the list of these partners will be updated in real time in the protocol. Another assumption we make is that since crypto is

still a relatively immature industry, we should expect to see gradual improvements in credit quality over time.

One of the core principles of risk management is called the *Single Investment Limit (SIL)*, which concerns the allocation of investments to low risk, medium risk and high risk platforms, subject to the governing CAR ratio. For example, if $95\% < CAR < 110\%$, the allocation to high risk protocols should not exceed 8% individually and 20% collectively; the allocation to medium risk protocols should not exceed 20% individually and 50% collectively; and, the allocation to low risk protocols should not exceed 40% individually.

We apply these key assumptions in our financial modeling to simulate the possible outcomes of our investments in all market conditions, and the result supports the theory that is outlined here (refer to financial modeling for more details).

3.3. The ASP and open market operations

The Algorithmic Stability Protocol (ASP) is created with the primary goal of stabilizing the system (figure 3). Initially, liquidity for the tracercoins will be provided in the form of a tracercoin/stablecoin pair on a Uniswap v2 AMM, which is the dominant AMM for DEXs in crypto currently. This allows the ASP to leverage the liquid reserve to rebalance the pool on a regular basis to support the price range.

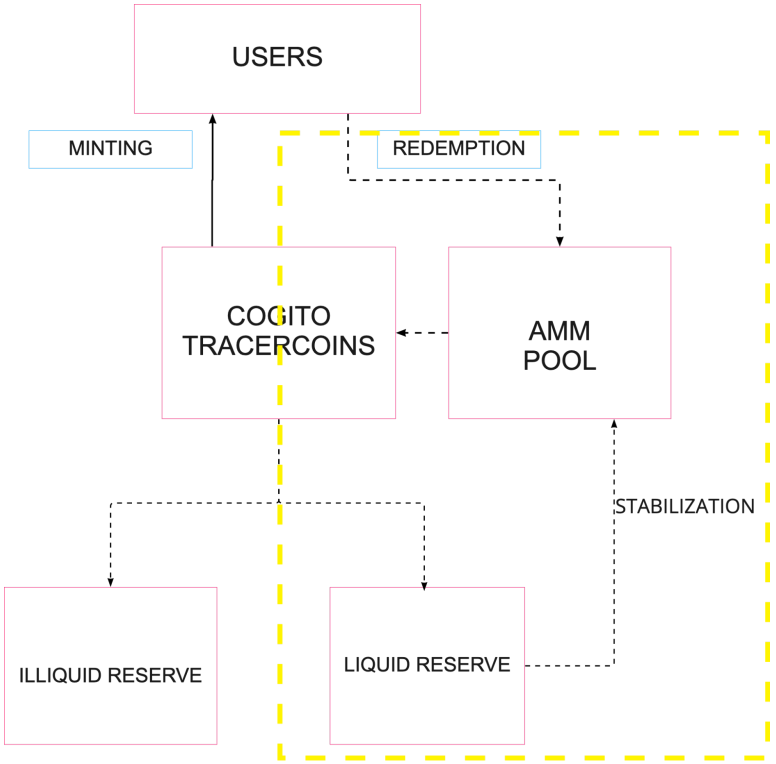


Figure 3. Algorithmic Stabilization Liquidity Pool (ASP)

As mentioned above, the ASF regulates the capital level, the allocation between liquid and illiquid assets, and the yield provided to users, in order to ensure that the price of the tracercoins is within

expected boundaries. The “invisible hand of the market” should be helping to stabilize the system by taking advantage of arbitrage from price disparities. If the market price is above the price target, an arbitrage opportunity exists to mint new tokens into the system and sell on the open market. On the other hand, if the market price is below the boundaries, there is an arbitrage opportunity to purchase on the open market for a discount and sell it to the ASP.

In the case where the market fails to work, the Cogito algorithm will come into play. The following describes the behavior of the algorithm during expansion and contraction periods.

Expansion: when the market price is above the price upper bound, this indicates more demand than supply. Based on the trading boundaries limits and the prevailing CAR, the protocol automatically increases the number of tokens in circulation, sells on the AMM curve, and gradually brings the price down to its target. This can be thought of as de-collateralization.

Contraction: If the market price goes under the lower bound, this indicates more supply than demand. The protocol utilizes the liquid reserve to purchase the tracercoins on the AMM curve, decreasing the number of tokens circulating and gradually bringing the price back up to its target. This has the effect of increasing collateralization.

However, suppose this automatic mechanism does not happen for some reason. In this case, the algorithm starts to take further actions to redeem tokens and decrease circulating supply. Parameters such as transaction costs, redemption fees, floating yield, and staking rewards may be adjusted. This will incentivize users to hold or sell back tokens to burn. Opportunities for open market operations can also be considered by using CGV tokens to buy back tracercoins.

Such a mechanism supports tracercoins’ price while additionally benefiting from arbitrage and trading fees, generating value for the protocol and its stakeholders.

Conclusion

We have described a hybrid protocol comprising of a new class of digital assets based on an algorithmic ecosystem that manages “tracercoin” tokens designed to increase in value smoothly and steadily over time, along with a separate CGV governance token. Cogito’s tracercoin tokens are different from any other stablecoins or cryptographic tokens because they are designed not to maintain a stable value relative to one or more fiat currencies or commodities, but are instead soft-pegged to non-financial indices that represent the steady progress of humanity.

We have also reviewed the algorithmic and economic mechanisms that will enable Cogito tracercoins to carry out this soft-peg. Regulated by the risk-weighted-reserve, the protocol dynamically updates the collateral ratio by taking into account price volatility, systemic risk, and ecosystem growth rate.

Autonomous stabilization functions form the core of the protocol. These functions adjust the capital adequacy ratio algorithmically to balance supply and demand of tracercoins, leveraging AI along with traditional quantitative-finance methods. The protocol is expected to enable a sustainable appreciation of tracercoins over the long run.

These tokens will fulfill the original vision of cryptocurrencies as digital monies: secure and privacy-preserving, democratic and decentralized in governance and operation, and stable enough to be used as stores of value and payment currencies.