Into the Secret Garden or a Dark Pool An Exploration into Whether Investment Gardens Provide an Investment Alternative for Retail Investors

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Abstract

This paper rejects the hypothesis that investment Gardens present financial harm to the public. Gardens are found on platform websites that allow anybody to create an investment product. The literature review sources the limited research noting the opportunities for abuse that managers of complex financial products can exploit against the unsuspecting public.

This research builds on the dialectic in the Decentralized Finance ("DeFi") debate. How dare access to riches be denied to anyone? Are regulators obliged to restrict access to vulnerable investors?

Eight Gardens are regressed against the S&P 500, Bitcoin and Ethereum prices. Granger Causality Analysis seeks to establish whether there is rationality in the DeFi markets. Gardens' Sharpe Ratios are compared to sixty traditional investment funds.

The paper proposes an extension of adverse selection within agency theory. The propensity for retail investors to understand a Garden from any sources should determine whether retail investors are allowed to invest.

Keywords: DeFi; game theory; adverse selection; investment gardens; finance democratization

JEL Classification: G1, G2, G5.

Introduction

"What if the people that [sic] know the opportunities share them and get rewarded?...you can choose to engage, join the conversation and discuss opportunities. Better yet, you can lead and suggest investment ideas to the community. In a group or community...

1. Other participants in the same group can endorse or downvote these ideas to ensure that only the best ideas rise to the top.
2. The best ideas will activate the pooled capital. The rewards for good ideas will be shared between the ideators, curators, and investors."

Recuero, R. (2021).

This statement on Decentralised Finance ("DeFi") gardens, pools, or sets, reflects the primary dialectic, currently being played out between the cryptoasset industry and financial regulators in Operation Choke 2.0 (Thompson et al, 2023). The cryptoasset industry argues for greater access to the finance sector so the public is not denied the financial returns available to the pejorative elites, whoever they may be: regulators see unacceptable risks being handed down to the public.

Thus DeFi becomes not only for the professional investors but "for the people" (Celo Foundation, 2022), democratising knowledge distribution and therefore, in theory, wealth creation. Where is this knowledge imparted? On website platforms. How is it fair?

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"…instead of using courts, laws and violence to govern how money is transferred between individuals and parties, we use open-source software, cryptography, and math" (Robertson et al, 2021).

Yet it is possible that regulators have not yet examined or do not even know about DeFi Gardens, Pools or Sets (hereafter referred to as "Gardens"). Certainly there is little academic research to alert them.

This paper sets out to confirm that Gardens present imminent dangers of financial loss to the public and therefore this asset class's contribution to the democratisation of finance through DeFi is, contrary to Recuero (2021), undesirable. It builds on a presentation made at the IEREK Conference on Disruptive Technologies: Innovations and Interdisciplinary Considerations of October 2023, and an extended abstract that will be published as part of conference proceedings.

The literature review cites adverse selection problems in principal-agent relationships (Pouryousefi & Frooman, 2019) and the limited research on financial fraud, which notes the opportunities for abuse that producer-managers of complex financial products can exploit against the unsuspecting public (Whitty, 2020 and Reurink, 2019).

The research is divided into three objectives. Part I seeks to discover whether Gardens have a clear investment strategy and sources Liang (2001) and Duanmu et al (2018) to regress each Garden against the S&P 500 and the Bitcoin and Ethereum prices. Part II ranks the risk-adjusted performance of Gardens and collective investment funds invested in the DeFi asset class by using the Sharpe ratio.

Parts I and II may be considered as simple investigations into whether Pouryousefi & Frooman's (2019) analysis of adverse selection holds, thus whether the research question is answered in the affirmative, that Gardens do present an imminent danger to investors.

Part III seeks to take the investigation deeper. Andrade and Newall (2023) cricitise cryptoassets as "Gamblified Financial Assets" which have gambling-style social effects. At this juncture, this research considers the concept of investor sentiment, on which academic literature can be traced as far back as 1988 (Solt and Statman, 1988). Specifically, Klemola et al (2016) and Lv et al. (2022) use vector autoregression and Granger Causality Analysis to consider whether investor sentiment affects markets, for example S & P 500 and the Shanghai Stock Exchange Composite Index. In particular, whether any such effect is exogenous. For this paper, the number of incidents of key fund and DeFi terms (obtained from Google Trends) in the previous 7 weeks were sought to conclude on whether DeFi gardens reflect investor sentiment: were they not to, then it would be harder for an individual to predict performance, exacerbating the adverse selection problem.

The results of Part I suggest that the adverse selection problem arising from information asymmetry is addressed to some extent. Parts II and III together suggest that, unless there is a time of cryptoasset market panic, Gardens tend to perform in a predictable way, i.e. according to investor sentiment, and indeed can outperform traditional collective investment funds that are invested in Decentralised Finance. Overall the research finds that gardens may not present an imminent danger to the public, although the paper concludes that Pouryousefi and Frooman's (2019) adverse selection model requires expansion to account for knowledge that a retail investor could deduce: called *post facto* contextual information symmetry.

Literature Review

Figure 2 shows key terms relevant for this paper.

The introduction referenced that DeFi has been an increasing phenomenon, particularly since 2020 (Arslanian, 2022). Recuero, the author of this paper's opening quotation and founder of Babylon Finance, claimed there were USD 40 billion assets under management at February 2021; an exponential growth from August 2020 of USD 6.3 billion (per DeFi Pulse). Even taking Belaşcu et al.'s (2022) more prudent estimate of USD 14.4 billion in February 2021, the growth is exponential.

The recent advent of DeFi (see Kim, 2021 and Arslanian, 2022) leaves only nascent literature from which to analyse Gardens, and this largely from the wider topic of DeFi. The literature review unearthed no specific research on Gardens. Nevertheless we may de-

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rive an idea of Gardens through Belașcu et al. (2022), who categorise DeFi asset management as composable. Schär (2021) describes composability as enabling a DeFi product to be built from individual pieces, like Lego. He further describes layers of sophistication of DeFi asset management, with Enzyme and TokenSets given as two examples of asset management Layer 4 aggregators. This research uses these two aggregators because they contain Gardens.

Belașcu et al (2022) agree with Schär (2021) that DeFi asset management protocols should algorithmically allocate capital to the highest returning yield, although the former is clearer in that the protocol's risk appetite should also be defined as a choice for investors. Both similarly agree on the risks, particularly *vis-à-vis* macroeconomics i.e. procyclicality, contagion, and cyber security. Belașcu et al. however go further, perceiving risks in asset/liability mismatches and the ensuing instability in product that will happen thereon. Thus Part II of this research looks not only at return but also at risk accounted for in the Sharpe ratio.

The challenges to a retail investor's decision-making are not limited to deriving an optimum risk adjusted return. Pouryousefi & Frooman (2019) contend for the principal-agent relationship being different from previous theory. They agree the agent has the greater knowledge, but not that the principal writes the contract. This is the opposite of Recuero's vision, quoted in the introduction, that Gardens would invest based on democratic decisions and all strategies would be voted on with perfect information shared. This paper needs to consider whether or not in Gardens agents, rather than the democratic caucus of investors, write the strategy. If agents do, then the tension in the principal-agent relationship has not been overcome in Gardens.

Pouryousefi & Frooman (2019) conclude that the agent's writing of contract leads to adverse selection problems, which may be defined as incorrect decision-making based on an informed agent but uninformed principal. They continue by subdividing the decision-making ability of the principal into a 2x2 matrix (Figure 1), distinguishing between the principal's access to observe and their ability to judge, or evaluate, information. Information asymmetry is abolished when the principal can see full information and understand it.

When the principal has good financial and technological literacy, but not full information, he/she can be said to have a blind spot, the implication of which can only be established depending on the specifics of the case. A state where he/she has full information, but cannot understand it, is described as *homoious hemin*, which Seery (1998), citing Lee (date unclear), allegorises as an "ordinary man [who] is often very uncritical in his beliefs".

Where the principal is neither able to judge or observe, Pouryousefi & Frooman describe a position akin to a ward of state, where the agent has an almost sacred, patristic duty to the principal.

There is no reason why this adverse selection model should not apply to DeFi. Certainly DeFi is complex, enabling Reurink's (2019) concerns in respect of traditional finance to translate to DeFi: complexity of financial products; retail investors' comparative financial illiteracy; *de facto* undisclosed investment strategies; and competitive pressures on agents not to discharge, in an unfettered manner, their fiduciary or regulatory duty to assess a principal's suitability for the product. Reurink (2019) further notes the disintermediation in traditional financial services through the advent of internet sales. This leads to a difficulty in establishing the locus of fiduciary duty, thus the person responsible for suitability assessment. This challenge applies to Gardens, which claim to be fully disintermediated.

Thus Part I of this research seeks to not only establish how clear the Garden's investment strategy is, but how easily performance can be assessed by a retail investor. In this, the research draws on Liang (2001) and Duanmu et al. (2018) and regresses, for each Garden, its value or price with the S&P 500 index (using Ordinary Least Squares with robust standard errors). Additionally, given that the objectives of the Gardens were designed to attract investors into the cryptoasset space, Gardens are regressed against Bitcoin and Ethereum prices, being market leaders in cryptocurrencies.

Finally, this literature review cannot ignore whether Andrade and Newall's (2023) work on cryptoassets as "Gamblified Financial Assets" would hinder the analysis of Parts I, II and III. They observe.

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"Cryptocurrencies can be traded around the clock and produce the allure of big potential lottery-like wins. Frequent cryptoasset traders often suffer from gambling-related harm, which suggests that many users are taking on substantial risks."

If Andrade & Newall are correct, then there would be an impact on this Paper in considering whether Pouryousefi & Frooman's analysis applies. If it does, then the argument would surely be that these frequent investors are Pouryousefi and Frooman's wards.

Methodology

Part I Ordinary Least Squares Regression

Following Schär's (2021) exposition of platforms, the research reviews the following platforms for Gardens of sufficient size and history: Enzyme Finance; TokenSets Asset Management Simplified; and dHEDGE. Babylon Finance Gardens are discounted due to insufficient history or comparable size to a collective investment fund. A decently sized traditional collective investment fund must be significantly in the millions of US Dollars.

The period under review was 1 September 2021 to 31 August 2022. Due to the need for there to be sufficient history, the lowest number of observations in a Garden was 288. Nevertheless, as Appendix B shows, there is only one Garden that would even be close to being considered comparable to an investment fund (DeFi Pulse Index).

Following Liang (2001) and Duanmu et al. (2018) each Garden is regressed with the S&P 500 Index, Bitcoin, and Ethereum prices (using Ordinary Least Squares with robust standard errors). The objectives of the Gardens are designed to attract investors into the cryptoasset space. Bitcoin and Ethereum prices are acknowledged as closely-correlated market indicators. It is therefore appropriate to regress against them as a proxy for the cryptoasset market as a whole.

Part II Sharpe Ratio

Next the research selects collective investment funds investing in a similar asset class, whether cryptoasset, metaverse or wider DeFi, from the Crypto Funds Register database. The definitions of investment strategy, and therefore asset class, are from the Crypto Funds Register. This avoids consistency of taxonomy problems highlighted by Zalan & Barbesino (2023), particularly with regards to the metaverse.

The observations of the selected collective investment funds and Gardens for this part of the exercise were from 30 September 2021 to 31 August 2022. Sixty collective investment funds operated during this period.

Excess returns were calculated using the yield on 3 month Treasury Bills as the risk-free rate.

The Sharpe ratio is calculated for each Garden using end-of-month prices and, for the funds selected from the Crypto Funds Register database, the Sharpe ratio is recalculated to take account of the precise time period under observation.

The research does not calculate the Treynor ratio as there is insufficient data to arrive at an individual beta for each collective investment fund and Garden. The only credible beta found was a simple crypto beta, calculated by the Chartered Association of Alternative Investment Analysts. Applying the same beta to the Gardens and collective investment funds would render a ranking equivalent to a non-risk-adjusted performance.

Part III Granger Causality Analysis

Due to the short time periods under review I also took Klemola et al.'s (2016) use of Granger Causality Analysis to test the hypothesis that key terms, totalled on a weekly basis through the use of Google Trends, would cause changes in the price of the Gardens. Were this to be the case, then this could be additional information available to retail investors to make a decision to invest. Such information might reduce information asymmetry and the adverse selection problem. The importance of the Granger Causality Analysis, as Klemola et al note, is that it also tests for the exogeneity of the trend and the prices.

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Term	Definition
Absolute return	either a positive return or a loss that has been "mitigate[d]…in the event of a market correction." (McCann(2014))
Collective investment fund	defined by the EU as "investment products created with the sole purpose of gathering investors' capital, and investing that capital collectively through a portfolio of financial instruments such as stocks, bonds and other securities. Investment funds play a crucial role in facilitating the accumulation of personal savings…for retirement."
Cryptoasset	per FATF's Glossary: "a digital representation of value that can be digitally traded, or transferred, and can be used for payment or investment purposes."
Decentralised Finance ("DeFi")	Disintermediated financial products (per Belaşcu *et al.* (2022)) using blockchain programmability to perform the service.
DeFi Gardens, Pools or Sets	Internet platforms which seek to remove an intermediary in the financial services industry by either utilising mathematics and programs (smart contracts) within, say, Ethereum (Belaşcu et al. (2022)) and/or providing a community where knowledge is imparted to the uninitiated. This paper uses the terms interchangeably.
Index tracker funds	Will typically try and track the performance of a financial index – mainly by investing in what comprises it (Hargreaves Lansdowne)
Minimum investment	Per Forbes Adviser most hedge funds have a minimum investment of USD 100,000 but can extend to at least USD 2 million
Professional investor	Per the FCA COBS 3.5.1 – elective professional client. A professional investor who has worked at least one year in a position that requires them to work the trades and has traded on their own account for at least 10 significant transactions each quarter over the previous ten quarters.
The Public	The retail sector. This paper takes the United Kingdom Financial Conduct Authority's (FCA) description: it is not a professional client or an eligible counterparty (COBS 3.4.1).
Regulation D of SEC Rule 506	Permits an accredited investor in an unregulated fund to be someone who can invest sufficient to be clearly of sizeable wealth, which is broadly USD 200,000 per annum annual income and net worth (excluding primary residence) above USD 1 million
Yield Farming	Per bitcoin.com the depositing of cryptoassets into a Decentralised Application, with the expectation of an interest return.

Figure 1: Relevant Terms.

	Principal can judge information	Principal cannot judge information
Principal can observe information	Symmetric information	*homoious* hemin
Principal cannot observe information	Blind-spot	Wardship

Figure 2: Pouryousefi and Frooman Adverse Selection.

The Analysis divides into two periods, rather than the three of Klemola et al (2016) due to the short history of Gardens. These two periods cover very different macroeconomic characteristics. One is commonly recognised as the Crypto Winter, from November 2021 to December 2022. The other, post Crypto Winter period, is from January 2023 to October 6 2023.

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This research's Granger Causality Analysis is based on Vector Autoregresion with key terms lagged over a seven-week basis. The dependent variable is the Garden, and independent variables are tested together against the Garden in a three variable Regression as per the clusters below:

Crypto Winter Relevant Terms

1. Cryptoasset + Gensler
2. Bitcoin ETF [exchange traded fund]

then

1. Ethereum
2. FAANG+

and finally

1. FAANG+
2. Bitcoin bubble

Post Crypto Winter Relevant Terms

1. Cryptoasset + Gensler
2. Bitcoin bubble

then

1. Crypto winter
2. Ethereum

plus

1. DeFi Worldwide
2. FAANG+

as well as

1. Short selling
2. Market neutral strategy

and

1. Crypto shark
2. Short selling

finally

1. Convertible arbitrage
2. Long short

All are tested in the direction of Google Trend term to Garden. In each case, the null hypothesis is that the number of mentions of the relevant term on Google Trend does not influence the price of the Garden.

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Using Klemola et al.'s notation

$$(\Delta g) = \beta_0 + \sum_{s=1}^{7} \beta_s(\Delta g) + \sum_{s=1}^{7} \beta_s(\Delta v_1) + \sum_{s=1}^{7} \beta_s(\Delta v_2)$$

where g is the dependent variable, the Garden, v_1 is the first independent variable and v_2 is the second independent variable, as described above.

The reason for different relevant terms for the two periods is the aforementioned changing circumstances of each season. For example, exchange traded funds were unlikely to be launched in the *post* crypto winter period due to the robust views of the US Securities and Exchange Commission, therefore the mention of [Gary] Gensler is sufficient as a term. Similarly, mentions of Crypto Winter during the season itself would be so high that there would be no discernible trend to be observed.

Results
Part I Ordinary Least Squares Regression

As stated in the methodology, in accordance with Liang (2021) and Duanmu et al. (2016) the research conducts pairwise correlation of the log in the change of performance in Gardens to the log of S&P 500, the log of bitcoin, and the log of Ethereum prices. The results are shown in Appendix B. Graphical representations are shown in Appendix A.

Appendix A discusses each Garden's performance in more detail and, from this, a comparison with the clarity of investment strategy. In summary:

		Performance	
		Good	Poor
Strategy	Clear	5	1
	Unclear	1	1

Figure 3: Performance against Clarity of Investment Strategy.
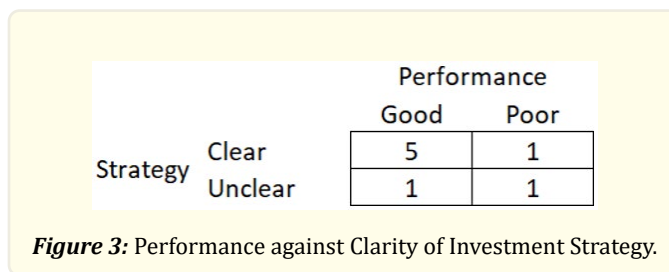
In Figure 3, good is defined as either a strong price performance, or one in keeping with the investment strategy. Thus there is a suggestion that clear strategies lead to better price performance. Using Pouryousefi and Frooman's Adverse Selec--tion model, here is clarity that can be judged. We may tentatively conclude that, if they may be clearly judged, then Gardens could be appropriate investments for retail investors.

Part II: Comparison of gardens with Cryptoasset Hedge Funds

It is however worth checking that there is some merit in investing in Gardens at all. For this to be the case, there should be better performance in Gardens than traditional investment funds investing in the DeFi asset class.

Appendix C shows the top ranked 21 Gardens and collective investment funds by Sharpe Ratio. Below number 21 the Sharpe ratio is negative, suggesting that no-one should invest as the mean return is less than the mean risk-free rate of return. This result is unsurprising, because the period of time under review for Part II is from 30 September 2021 to 31 August 2022, the latter part of the period dominated by the so-called Crypto Winter. In this period, losses in the DeFi sector were enormous and widespread. This also emphasises the importance of the Part III work being subdivided into two distinct macroeconomic periods, covering the Crypto Winter and post Crypto Winter.

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Four of the top five are Gardens. The table in Appendix C suggests, on limited data, that Gardens may be more favorable to investors than this Paper's hypothesis proposes.

Part III Granger Causality Analysis
Crypto Winter

Appendices D and E show the Granger Causality Analysis for the Crypto Winter and the post Crypto Winter period, as defined in the methodology.

Analysis of Results for Crypto Winter

What the results do suggest is that Ethereum internet traffic does seem to influence prices in a minority of Gardens.

These results do not convincingly suggest a connection between relevant terms and prices, and perhaps can only suggest that, in a period of panic, such as the Crypto Winter, there is no price information within investor sentiment. This is not entirely surprising, as Klemola et al. acknowledged the conflicting literature on the link between investor sentiment and prices.

Some robustness to this proposition may be offered by DH Stablecoin Yield having, seemingly, no suggestion of correlation with any term. This is not unreasonable, given that it invests in assets that are pegged to a fiat currency. Here there would be other drivers, endogenous to the individual stablecoins, that would determine price. Similarly, as mentioned in the Figure 2 in the literature review, yield farming works in a similar manner to interest, rewarding for holding (or HODLing to use the appropriate DeFi slang). Therefore the demand is not solely based on price but also yield.

Analysis of Results for Post Crypto Winter

With few exceptions (please see Appendix D), there is suggestion that selected DeFi and invest-ment fund terms correlate with changes in Garden prices. The significant exception was DeFi Yield Farming and Trend. This should not be a surprise as its price would also be affected by changes in staking yield, as discussed above in respect of DH Stablecoin Yield.

This would suggest that investors could seek to derive price information from Google Trends terms, and therefore there is a possibility of reducing the information asymmetry in the adverse selection problem.

Discussion of Results

The above results have placed considerable doubt over this paper's hypothesis that Gardens present an imminent danger of financial loss to retail investors. Part II of the research suggests that four Gardens outperform all but one of the sixty traditional collective investment funds invested in the DeFi asset class.

Nevertheless, the *caveat* is that the other four Gardens selected in the sample have negative Sharpe ratio, and therefore present a mean return below the mean risk-free rate. Whilst these results are in the time of the Crypto Winter, discussed in the previous section, it does reinforce that Gardens should still be approached with caution by the public.

Part III of the research suggests that, in a nonpanicked market, investors even retail could derive price information from key DeFi and investment fund terms. In so doing, this would help to reduce the adverse selection problem.

Finally, Part I suggests some correlation between clarity of strategy and relatively successful performance.

Thus this research into Gardens invites careful reconsideration of the propositions of Pouryousefi & Frooman (2019). In particular the propositions are limited by not considering the divergence of investment appraisal. Investors would appear to be able to make an investment decision based not only on the past performance of this investment, but also on a comparison of this performance to the investment strategy outlined (the contract in Pouryousefi and Frooman's adverse selection analysis).

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dHedge Yield Farming and Trend is a case in point. *prima facie* the strategy seems confusing:

"You can put any amount you like into this pool, and I will try to manage the risk. This means, the returns will be lower than in high-risk pools, because we'll trade only with 10% to 50% max.

"*I might update this description if I decide to adjust the strategy a bit.*"

The italics are my emphasis. If ever there were a more obvious agent-written contract…

However, the creator of dHedge Yield Farming and Trend may be neurotically over-conscientious, rather than deliberately obtuse, seeking to disclose to investors possibilities in different states of the world. This idea, of a conscientious manager, may indeed be supported by the broadly stable return the pool has provided for investors, as shown in Appendix A: certainly the low-risk approach disclosed appears to have paid off.

This example ably exposes the limitation to Pouryousefi & Frooman's (2019) work. Where the performance is understandable, despite its meandering investment strategy, surely most investors would be competent to judge whether the Garden is a good investment. If, to mimic one of the United Kingdom's legal tests for market abuse within the UK Financial Services and Markets Act, an independent regular user would be able to see the reasonability of the performance in the light of the objective, then an investor could both judge and observe. As I note in respect of dHedge Yield Farming and Trend, Appendix A, performance can be reasonable in the context. The proposition is that this concept could be added to Pouryousefi & Frooman's Table and named *post facto* contextual information symmetry.
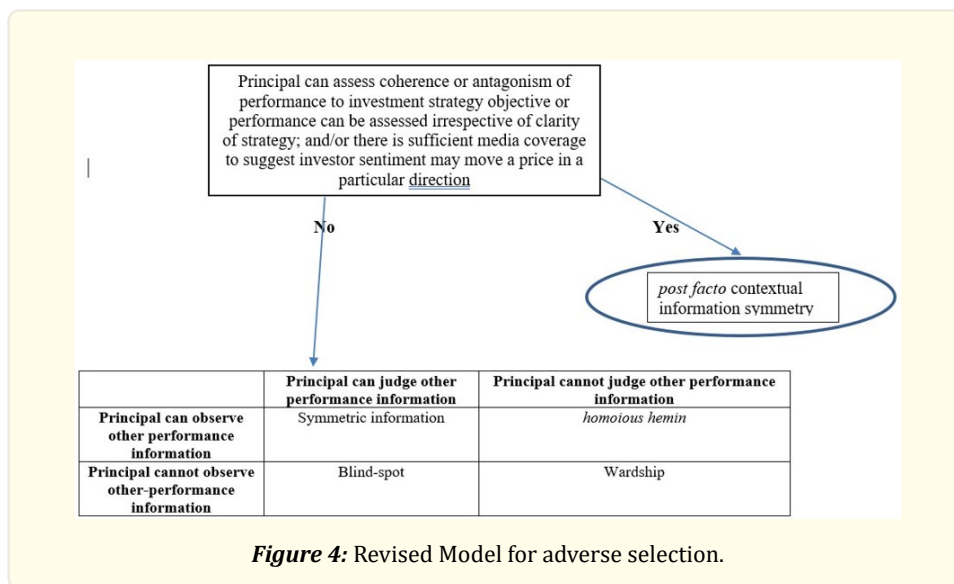
Now take the other fund with unclear objective, Enzyme Civa. This would appear to fall within Pouryousefi & Frooman's (2019) definition of wardship. It disclosed its current holdings, but there was no strategy/objective given. Its performance was abject. This may suggest that, in the absence of a clear strategy to which the agent can be held accountable, failure might have been inevitable. This is a strong statement, but not without merit. If it is not without merit, it would seem reasonable to argue this is also *post facto* contextual information symmetry: an unclear strategy, so steer clear investors.

Now, add to the above the findings of Part III. Assuming we are not in a market panic, there would appear to be a reasonable finding from this research that investors could also make a decision based on investor sentiment, by for example following DeFi specialist journalists or blogs, in the same way as Tetlock (2007) observed the effects of Wall Street Journal commentary on prices.

Combining the arguments above, *post facto* contextual information symmetry may be defined as *an investment decision made by the principal on the basis of information that might not be clear from the investment objective/strategy, but the performance of the Garden is sufficiently coherent with, or antagonistic to, the principal's interpretation of the objective/strategy; or has performed either well or badly irrespective of the clarity of the strategy; and/or there is sufficient media coverage to suggest investor sentiment may move a price in a particular direction.*

Figure 4 demonstrates the extension of Pouryousefi & Frooman's (2019) adverse selection table into a flowchart.

First we consider whether there is performance data, and how clearly coherent or antagonistic it is to the investment strategy objective or to the investor's own perception of good performance. And/or whether there is sufficient internet coverage to suggest investor sentiment may move a price in a particular direction. If it can be assessed, then we have *post facto* contextual information symmetry. If it cannot be, then Pouryousefi & Frooman's table should be consulted in terms of clarity of contract i.e. investment strategy.

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Figure 4: Revised Model for adverse selection.

Application of Revised Adverse Selection Model to the other Gardens

Now to illustrate this model's application in respect of the other Gardens.

Two index Gardens were procyclical as expected, but with nuances. One, dHedge Top Index, did track Bitcoin and Ethereum downwards, but the data shows some performance mitigation. Again, an investor could consider this performance mitigation in the light of *post facto* contextual information symmetry. The other, TokenSets DeFi Pulse Index, performed worse than Bitcoin and Ethereum with higher positive correlation coefficients. Again an investor could assess this, via *post facto* contextual information symmetry, as a poor investment opportunity.

Meanwhile, TokenSets Metaverse Index did far worse than Bitcoin and Ethereum. Nevertheless this also could fall to be assessed within *post facto* contextual information symmetry, given that it is well known that FAANG+ had a terrible year in 2022.

TokenSets Sushi DAO House remains somewhat of a mystery in terms of clarity of strategy. However an investor could assess it under *post facto* contextual information symmetry, very positively, given the high Sharpe ratio. An investor could see this ratio and rationally decide to invest.

Limitations to this research

There is one fundamental *caveat* to the findings of this research. The data on Gardens is from web site platforms and, whilst one might expect the platform provider to have ensured the accuracy of the performance data provided, there is no reassurance this is the case. Certainly there is no suggestion of independent audit. Thus all the data could have been manipulated not necessarily to the point of incredulity, but to a point of mitigated losses or inflated gains. Platforms need to provide academic researchers and investors with independently verifiable and audited data for there to be greater confidence in any research findings.

In the absence of such checks and balances, it is difficult for an investor to see how the agent has discharged its fiduciary duty to the Garden. And similarly it is difficult to judge how the platform has allowed a manager on to its systems in the first place. It looks as if anyone can in the name of free market accessibility, cryptoanarchism evolved to DeFianarchism, and no less irrational.

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The research is also limited by being bookended within a short time of observation. This is due to the novelty of Gardens. For example, Part II avoids the Crypto Winter at its harshest, with its extreme and unanalysable price drops. Whilst the Sharpe ratio assumes i.i.d, a limited period from 30 September 2021 to 31 August 2022 means that all Gardens and collective investment funds are unlikely to be distributed normally. Attempting to solve this via logging the numerator and denominator of the Sharpe ratio could not be done due to some observations being negative.

For further examination on how retail investors would approach an investment decision into a Garden, research should consider their range of risk appetites. Additionally, the research did not find sufficient data to comment on Belaşcu et al.'s (2022) concern over risks in asset/liability mismatches and the ensuing instability in product that would happen thereon. Nor indeed was there data to follow up on Reurink's (2018) and Whitty's (2020) concerns of investor susceptibility to fraud. These three risk-focused pieces of research would be obvious next steps to build on this paper.

And what of Ramon Recuero's caring, sharing investment community? Babylon Finance announced its decision to shut down by November 15 2022. The reasons blamed the Rari/FEI hack. Whether or not the world was ready for Babylon, and certainly Recuero was no Xerxes conquering all, there has been an unknown quantum of loss of property. Good old-fashioned lack of secure custody put paid to that experiment and confirmed the cyber security risks outlined by Belaşcu et al. (2022).

As time passes, further valuable research could be performed on investors' ability to understand the specific cyber security risks and to what extent the cost to them of fast shutdowns such as Babylon Finance is known and therefore priced into their decision to buy/hold/sell Gardens. Such work would need to consider whether platforms for Gardens need to also consider burial grounds, i.e. regulation insisting on living wills.

Conclusion

In respect of DeFi Gardens, this Paper proposes a revision to Pouryousefi and Frooman's (2019) adverse selection model. Whilst adverse selection challenges will always remain, there can be some mitigation through the concept of *post facto* contextual information symmetry. Such a concept allows for consideration of past investment performance against investment strategy, past performance on its own (via the Sharpe ratio), and online investor sentiment.

In any event, the hypothesis of the Paper has not been convincingly supported. If anything, there is a suggestion that Gardens could be a suitable alternative investment for retail investors.

Appendix A
Comparison of selected Gardens with Bitcoin, Ethereum and S&P 500

Appendix B summarises each Garden's strategy.

DHedge Stablecoin Yield

This strategy is clear and has worked well, showing price stability. In this respect it has outperformed Bitcoin and Ethereum, but perhaps this is not surprising given the exposure to Frax. As the author's previous paper proposed, Frax, with its partial algorithmic trading, would be more likely to stay pegged to the US dollar than most stablecoins (Le Page, 2022). In any event, there is certainly minimal cross-elasticity between this Garden, Bitcoin and Ethereum. Compared to S&P 500 its performance has held up.

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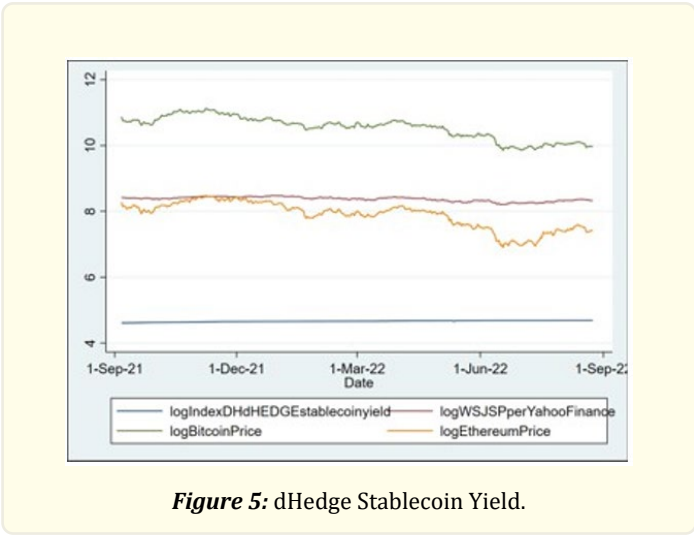
Figure 5: dHedge Stablecoin Yield.

dHedge Top Index

The dramatic crypto collapse in May/June 2022 is muted somewhat within the dHedge Top Index performance, and this is borne out by the coefficients shown in Appendix B. The muting would suggest the clear strategy has, to a degree, worked.
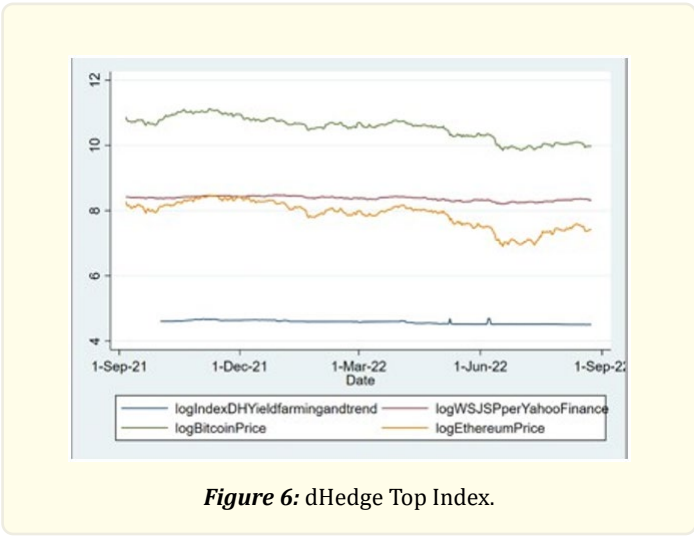
Figure 6: dHedge Top Index.

dHedge Yield Farming and trend

The vague, and allowance for many possibilities, investment strategy has at least produced, albeit for a small term, a broadly stable return, largely in line with the S&P 500. Investors would find it difficult to argue against this performance.

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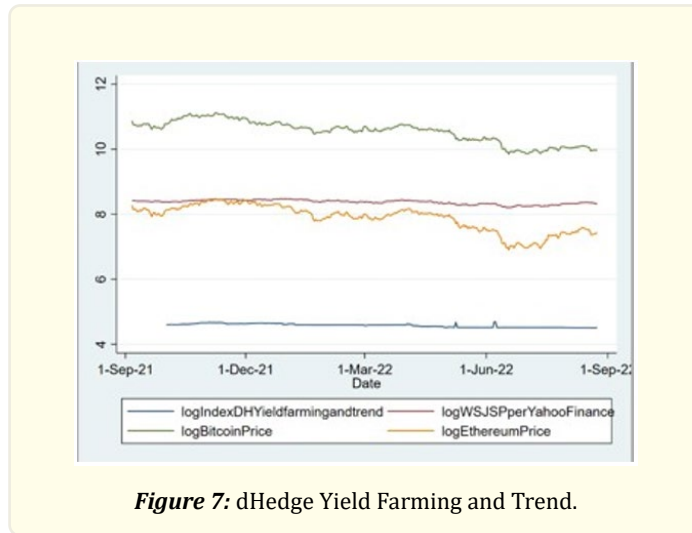
Figure 7: dHedge Yield Farming and Trend.

Enzyme Civa

There was no clear investment strategy given. The performance mirrors and strongly correlates with Bitcoin's and Ethereum's devaluation. The performance since its inception in November 2021 is poor.
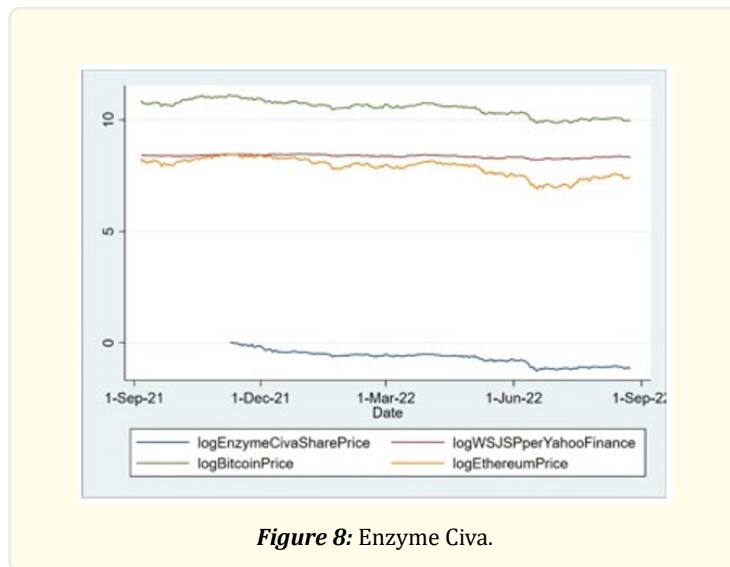
Figure 8: Enzyme Civa.

Enzyme Defiable Mid Small Caps

The language of absolute return and hedge fund defines the strategy. The results define failure, with no mitigation in performance apparent.

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Figure 9: Enzyme DeFiable MidSmall Caps.
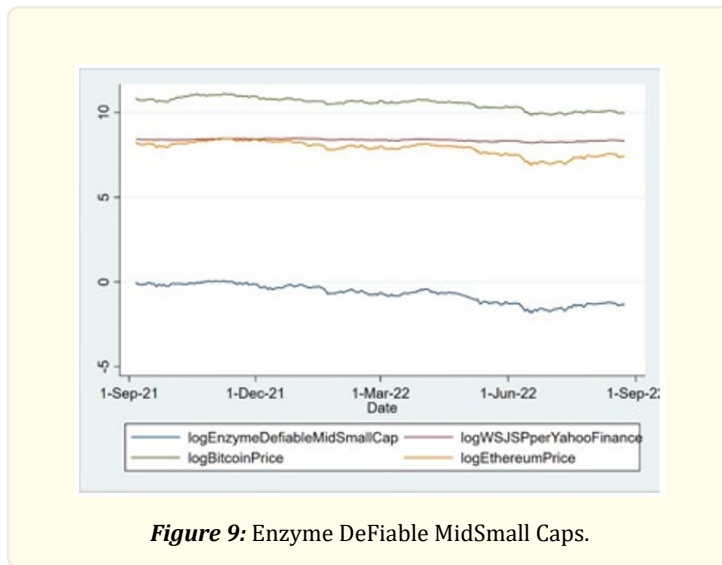
TokenSets DeFi Pulse Index

As shown in Figure 10, the losses in the cryptocurrency sector, exemplified by Bitcoin and Ethereum, are not mitigated. As an index tracker, this is unsurprising.

Figure 10: TokenSets DeFi Pulse Index.
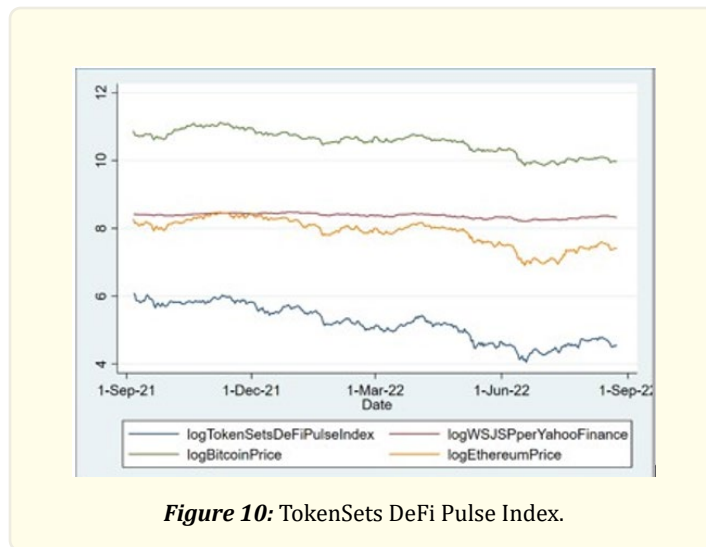
TokenSets Sushi DAO House

Note (b) to Appendix B, Figure 11, presents the investment strategy. Per Figure 11 there is a subone positive correlation to Bitcoin and Ethereum in the OLS regression. Therefore it might be argued the Garden has done what the strategy said.

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Figure 11: TokenSets Sushi DAO House.
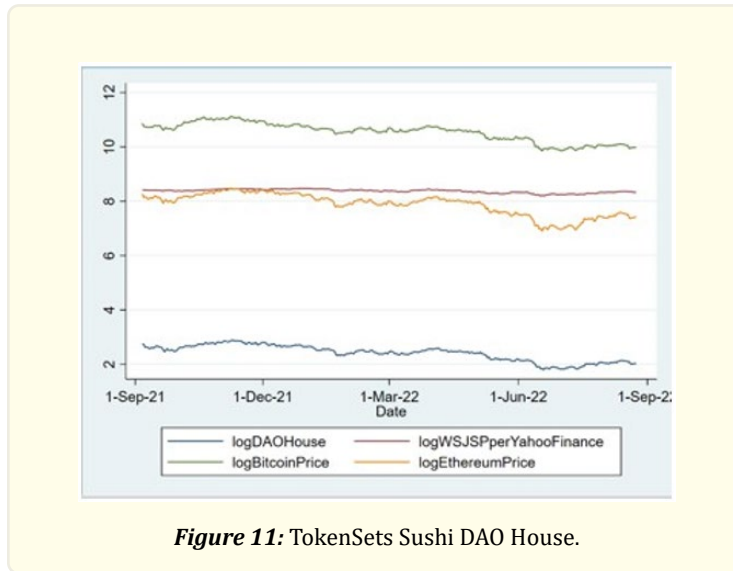
TokenSets Metaverse Index

Figure 12 and Appendix B demonstrate that the Metaverse Index has had an even more volatile time of it positively and negatively than crypto. It would, despite the opacity of the strategy, be hard to argue against this performance given the year under review, that even adversely impacted on the FAANG+.

Figure 12: TokenSets Metaverse Index.

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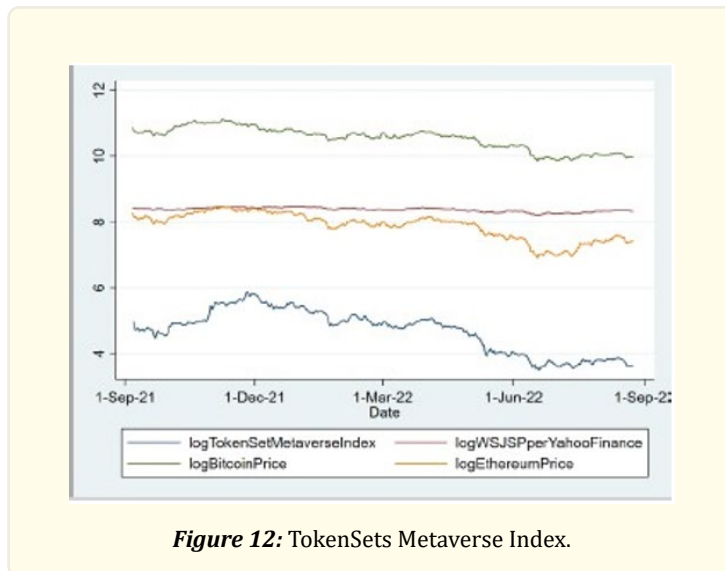
Appendix B Summary of Gardens, including OLS Regression

Platform	Name	Assets under Management in August 2022 USD	Number of investors (No of observations)	Start Date	Strategy	Coefficient S&P 500 (p-value)	Coefficient Bitcoin Price (p-value)	Coefficient Ethereum Price (p-value)
dHedge	dHEDGE Stablecoin Yield	1,960,000	1,153 (353)	1 August 2021	Algorithmically farm highest yield stable pool. Exposure to FRAX, USDC, DAI, USDT	-0.193 (0)	-0.0469 (0)	-0.037 (0)
dHedge	Top Index	802,100	247 (353)	1 April 2021	Actively Managed index, tracking best dHedge traders	3.27 (0)	0.689 (0)	0.578 (0)
dHedge	Yield Farming and Trend	254,700	4 (314)	2 October 2021	See Note (a)[1]	0.630 (0)	0.133 (0)	0.107 (0)
Enzyme	Civa	1,136,011	147 (288)	Not available	Discloses token holdings and currently no leverage, no clear strategy given	3.837 (0)	0.937 (0)	0.7243 (0)
Enzyme	Defiable Mid Small Cap	684,876	57 (353)	May 2021	Long/short Multi-strategy	7.229 (0)	1.490 (0)	1.257 (0)
TokenSets	DeFi Pulse Index	32,463,347	15,665 (353)	9 September 2020	Tracks DeFi Pulse Index	7.08 (0)	1.45 (0)	1.222 (0)
TokenSets	Metaverse Index	5,783,690	10,348 (353)	2 April 2021	Tracks Metaverse Index: entertainment, sports, business going to metaverse.	8.96 (0)	1.74 (0)	1.502 (0)
TokenSets	Sushi DAO House	4,254,762	4 (351)	27 May 2021	See Note (b)	3.96 (0)	0.8302 (0)	0.705 (0)

Figure 13: Summary of Investment Pools' Correlation with S&P 500, Bitcoin Price, and Ethereum price.

Note (a) dHedge Yield Farming and trend: "The strategy is:Keep the largest part of the portfolio in low-risk LP yield farming at all times…Buy some interesting coins when there is a clear uptrend in the complete space (meaning in BTC), and let the profits run until the trend turns around. Trends will mostly run for weeks or months, and I won't swing-trade much in between. You can put any amount you like into this pool, and I will try to manage the risk. This means, the returns will be lower than in high-risk pools, because we'll trade only with 10%-50% max. I might update this description if I decide to adjust the strategy a bit."

Note (b) "…actively Managed Portfolio that is governed by the Sushi DAO. The investment objective…is to preserve capital and minimize risk during a market downturn in order to support the long term growth and development of the Sushi Ecosystem. This allows a more dynamic allocation of assets with better risk handling and analysis without loss of decentralization. sushiHOUSE is the one of Yam.Finance's 'DAO House' risk products designed to serve as a DAO cornerstone for achievement of future growth and ongoing success."

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Appendix C Ranking of Gardens and Crypto Funds by Sharpe Ratio

Rank	Name	Mean Excess monthly returns over monthly risk free rate	Standard deviation of return	Sharpe ratio
1	TokenSets Sushi DAO House	0.5147688	0.282067	1.82498768
2	DH dHedge Stablecoin yield	132.4926	92.75612	1.428397393
3	TokenSets DeFi Pulse Index	1.284234	1.510618	0.850138155
4	Non-Directional Fund	2.613272	3.104797	0.841688523
5	TokenSets Metaverse Index	1.0771734	1.509506	0.713593321
6	Icoinic Delta Neutral	1.863992	2.635546	0.707250794
7	Digital Opportunities Class	0.5459007	0.7767117	0.702835685
8	Ada Capital Fund	0.4950673	0.805705	0.614452312
9	Elysium Global Arbitrage Fund	3.420067	6.418919	0.532810431
10	Delta Neutral Fund	0.7400673	1.653554	0.447561616
11	Altana Specialty Finance	10.72507	34.67657	0.309288664
12	Eltican Neutron SP	1.883401	6.723664	0.280115276
13	Genesis Alpha Fund	13.15173	49.46581	0.265875157
14	Axon Global Fund LP	2.928401	14.48374	0.202185416
15	Full Strategy Fund	0.461224	2.56002	0.180164217
16	Bohr Arbitrage Crypto Fund	1.245067	8.855363	0.140600335
17	Lavaliere Capital, LP	8.277567	90.80263	0.091159992
18	The Etherbridge Fund	3.9534	51.26149	0.077122222
19	Alt Tab Capital	1.498401	21.07689	0.07109213
20	AD Long Short Fund	0.0325673	1.184372	0.027497526
21	Crypto Asset Fund, LLC (Class X)	0.0059007	2.930372	0.002013635

Figure 14: Top 21 Crypto Hedge Funds and Pools by Sharpe Ratio.

Appendix D: Granger Causality Analysis of selected terms to Gardens post Crypto Winter

Dependent Variable Δ TokenSets Sushi				Dependent Variable Δ Token. DeFi Pulse				Dependent Variable Δ Enzyme Mid-Small Cap				Dependent Variable Δ Dhedge Top Index			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Cryptoasset+Gensler	28.25	7	0.000	Cryptoasset + Gensler	56.804	7	0.000	Cryptoasset+Gensler	55.021	7	0.000	Cryptoasset+Gensler	19.752	7	0.006
Bitcoin bubble	38.17	7	0.000	Ethereum	66.835	7	0.000	Bitcoin Bubble	14.87	7	0.038	Bitcoin bubble	34.675	7	0.000
ALL	63.139	14	0.000	ALL	143.21	14	0.000	ALL	68.238	14	0.000	ALL	57.68	14	0.000
Cryptowinter	37.991	7	0.000	Cryptowinter	21.535	7	0.003	Cryptowinter	32.655	7	0.000	Cryptowinter	33.222	7	0.000
Ethereum	87.753	7	0.000	Ethereum	42.9	7	0.000	Ethereum	36.299	7	0.000	Ethereum	125.59	7	0.000
ALL	122.36	14	0.000	ALL	55.34	14	0.000	ALL	67.207	14	0.000	ALL	183.17	14	0.000
DeFi Worldwide	41.453	7	0.000	DeFi Worldwide	8.0949	7	0.324	DeFi Worldwide	10.895	7	0.143	DeFi Worldwide	21.112	7	0.004
FAANG +	59.823	7	0.000	FAANG+	10.698	7	0.152	FAANG	17.575	7	0.014	FAANG+	23.549	7	0.001
All	101.46	14	0.000	ALL	22.013	14	0.078	ALL	25.608	14	0.029	ALL	71.912	14	0.000
Short selling	71.934	7	0.000	Short selling	43.57	7	0.000	Short selling	28.728	7	0.000	Short selling	60.200	7	0.000
Market neutral strategy	11.369	7	0.123	Market neutral strategy	40.337	7	0.000	Market neutral strategy	97.39	7	0.000	Market neutral strategy	7.663	7	0.363
ALL	98.096	14	0.000	ALL	103.93	14	0.000	ALL	169.6	14	0.000	ALL	76.024	14	0.000
Convertible Arbitrage	24.025	7	0.001	Convertible Arbitrage	26.341	7	0.000	Convertible Arbitrage	74.195	7	0.000	Convertible Arbitrage	62.326	7	0.000
Long-short	8.8802	7	0.261	Long-short	6.8832	7	0.441	Long-short	38.196	7	0.000	Long-short	25.881	7	0.001
ALL	28.33	14	0.013	ALL	41.552	14	0.000	ALL	109.73	14	0.000	ALL	64.363	14	0.000
Crypto shark	28.885	7	0.000	Crypto shark	11.796	7	0.107	Crypto shark	25.306	7	0.001	Crypto shark	24.511	7	0.001
Short Selling	117.24	7	0.000	Short Selling	38.449	7	0.000	Short Selling	38.101	7	0.000	Short Selling	111.13	7	0.000
ALL	150.64	14	0.000	ALL	50.3	14	0.000	ALL	57.287	14	0.000	ALL	121.91	14	0.000

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	Dependent Variable Δ Enzyme Civa				Dependent Variable Δ DH Stablecoin Yield				Dependent Variable Δ DH Yield Farming and Trend		
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
Cryptoasset+Gensler	48.187	7	0.000	Cryptoasset+Gensler	14.763	7	0.039	Cryptoasset+Gensler	19.281	7	0.007
Bitcoin bubble	39.769	7	0.000	Bitcoin bubble	47.533	7	0.000	Bitcoin bubble	11.316	7	0.125
ALL	91.114	14	0.000	ALL	51.204	14	0.000	ALL	41.48	14	0.000
Cryptowinter	45.068	7	0.000	Cryptowinter	18.324	7	0.011	Cryptowinter	14.02	7	0.051
Ethereum	67.875	7	0.000	Ethereum	126.76	7	0.000	Ethereum	47.424	7	0.000
ALL	105.48	14	0.000	ALL	140.19	14	0.000	ALL	87.193	14	0.000
DeFi Worldwide	23.854	7	0.001	DeFi Worldwide	17.921	7	0.012	DeFi Worldwide	29.907	7	0.000
FAANG+	30.64	7	0.000	FAANG+	17.498	7	0.014	FAANG+	32.112	7	0.000
All	48.067	14	0.000	All	57.939	14	0.000	All	122.35	14	0.000
Short selling	70.985	7	0.000	Short selling	111.33	7	0.000	Short selling	17.718	7	0.013
Market Neutral	32.832	7	0.000	Market Neutral	22.172	7	0.002	Market Neutral	5.4076	7	0.610
ALL	127.3	14	0.000	ALL	121.14	14	0.000	ALL	19.625	14	0.142
Crypto shark	23.872	7	0.001	Crypto shark	5.4105	7	0.610	Crypto shark	14.873	7	0.038
Short selling	72.258	7	0.000	Short selling	69.57	7	0.000	Short selling	29.058	7	0.000
ALL	105.29	14	0.000	ALL	73.759	14	0.000	ALL	32.688	14	0.003
Convertible arbitrage	19.811	7	0.006	Convertible arbitrage	8.6687	7	0.277	Convertible arbitrage	38.623	7	0.000
Long short	6.5983	7	0.472	Long short	6.0109	7	0.538	Long short	0.36758	7	1.000
ALL	23.792	14	0.049	ALL	9.6584	14	0.787	ALL	41.17	14	0.000

Figure 15: Granger Causality Analysis post Crypto Winter.

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