

Project Crowbar

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Abstract

"It's almost impossible to test that hypothesis, except through the two questions that I've asked - can you beat the market and are prices right?" ²⁵⁾ that is what Richard Thaler said in debate with Eugene Fama with regards to Effective Market Hypothesis (EMH). With proposed framework, using technologies like blockchain, cryptocurrency and prediction markets, we can answer both. And not only those. As the test of EMH would be the just a first case that will help to structure the framework for answering that hard questions unambiguously. So, regardless of answers, with the first use case resolved - the test of EMH - we will either drop shadow on few Nobel prizes and established theories in economics and produce very useful tools for portfolio management and trading (wallet app with integrated trading capability for onchain fee-less decentralized exchange). Or, depending on outcome, will reinforce the process of healing humanity from, supposedly, tremendously wasteful industry with estimated volumes of trillions USD per day, and help to redirect those funds into undoubtedly crucial areas, like space exploration and healthcare. Again, in both cases, valuable empirical evidence and statistical data on new asset classes will be produced.

1. Introduction

In economics and finance, agents are called to make daily decisions about what goods and services to consume, what assets or portfolio of assets to hold under different types of constraints, mainly wealth constraint. For instance, in the Modern Portfolio Theory, if investors are faced with portfolios with similar returns, they would choose the one that minimizes the risk. This choice under constraint allows the theorist to derive predictions about the behavior of the agent, which can then be tested against real world data using statistical techniques.

The importance of statistics in economics and finance cannot be emphasized enough. There are countless cases in economics and finance where statistics play a key role. One of the key tool of statistics applied in finance is the probability theory. Most the variables used in economics and finance are random, or not not known a priori, such as asset prices, cash-flows, trading volume, and so on. Random variables are characterized by probability distribution that allows the reconstruct figures such as the mean and the standard deviation.

Though many investors use their subjective probability when buying and selling assets, Fama's EMH maintains that an asset price contains all the necessary information investors need to know and this is done through what is called price discovery process to unveil the hidden probabilities that govern price movements ¹⁴⁾. Other applications of statistics include the stochastic processes that model the price as a geometric Brownian motion and the Black-Scholes formula for option pricing.

2. Concept

This project aims to template complex statistical test, outcomes of which would be decided based on unambiguous methods of data entry and interpretation via

consensus tools like blockchain and smart contracts. So that the formalized outcome can be supplied by the oracle-like plugins to various aggregation tools like prediction markets.

Unambiguous data entry would comprise of interface to smart contract with possible segregation to UI for human-only and API for software-only interaction. The oracle-plugin would, in turn, be a host for various plugins that would implement many statistical and mathematical filters and sub-tests, also in an unambiguous way via open source smart contracts. So that oracle authors would not have to be experts in every transform they want to apply or test, but rely on established, peer-reviewed immutable implementations provided by incentivized community.

Unambiguous data interpretation would be ensured by formalized resolver smart contract, coded in consensus and peer-reviewed by different camps with opposite views.

3. Proposed test

First proposed test, that would template be based on, is test of weak form(WF) of Market Efficiency Hypothesis(MEH).

According to various sources ^{6) 7) 18)} such tests had mixed or ambiguous results. For example finding flows in a tested model by proponents of opposite views resulted in claims of ambiguousness ¹⁾ or deemed EMH not “falsifiable” theory ¹⁸⁾. Also many findings noted predictability of historical data of different degree ^{1) 6) 7) 8) 14)}, but found impossible to exploit them when transaction costs were applied ^{8) 9)}. Some sources reported inefficiency in emerging markets ¹⁰⁾ A lot of experiments on this subject are quite dated ^{1) 14) 16)}, conducted by lone researcher ^{7) 10) 14) 16)} or teams with aligned views ^{1) 3) 5) 12)}. All past tests were conducted on old assets classes. With invention of

cryptocurrencies, relatively high liquidity pools with zero transaction fees became possible. For example Bitfinex exchange offers maker zero fee tier ¹⁷⁾ depending on a monthly volume - with such option it's possible to execute pair of purchase/sell orders of ~10 BTC depth that will result in a same balance as before transaction, on a volatility level close to 0%. Leveraged trading that was available on Chinese exchanges before government crackdown, like OKex, BTCC and Huobi - also allowed feeless orders, regardless of a monthly volume. The small spread that was effective there didn't allow to zero transaction cost(ZFT) trade, but the effective transaction cost was as low as ~0.015% on a BTCC exchange. Automated exchange protocols like Bancor that itself allows ZFT (but of limited use for high frequency trading (HFT) due to high transaction cost of Ethereum blockchain), if implemented on upcoming zero fee transaction blockchain like EOS, could trivialize HFT with ZFT. Thus making transaction cost argument (one among the most frequent EMH-supporting arguments for non-exploitability of historical data ^{8) 9) 15 22) 23) 24)}) invalid.

On the other hand - there were lots of automated trading contests and championships ^{20) 21)}. Some were running on Forex with MQL and Metatrader ²¹⁾, now there are contests for automated trading on cryptocurrency exchanges. Each year they pop out some winners ²⁰⁾. Seems like discovery of strategy that reliably exploits market inefficiency would lead to unlimited stream of money - yet the winners come and go ²¹⁾. And the raw statistical data obtained in those contests isn't public, as developers of automated trading tools seems are not interested in exposing raw statistics, thus again and again breathing new life in a hope for an ultimate trading bot.

Proposed test is a prediction market entry, will benefit science by empirical evidence ²⁾. It will be a bet of two groups against each other. One group is a skeptics group. Another - group of proponents of successful trading, would be divided into two sub-groups - adepts of manual and automated trading respectively. There will be trading contest running with segregated human/software interface to a smart contract

with data collection, trading engine integration and outcomes resolution. Human interface would consist of simple UI with basic buttons for purchase/sell. Automated part would consist of API modeled as simplified version of some major exchange like Bitfinex. The segregation would be enforced by captcha on manual (human) side and by simple arithmetic operation on big numbers with sub second timeout on assisted trading (software) side.

Smart contract with trading engine integration could interact with exchanges/trading smart contracts like Bancor. Also the number of zero fee crypto trading platforms is growing. Top entries from "no fee" daily volume chart of Coinmarketcap.com could be investigated and integrated like Bitmex or Cobinhood, Quinone among the ones with advanced APIs. Some major exchanges like GDAX, offer zero-fee maker orders and some trading strategies can be built on that. Speaking of Bancor(with option of effective zero fee) and Kyber Network as automated and decentralised exchanges - they would be ideal for undisputed data collection. High transaction cost of Ethereum can make it unusable - even if generated transactions would be as cheap as possible and valid, the result would be that they can end up stuck in Ethereum's unconfirmed transaction pool, possibly forever due to low gas cost. We mitigate this issue by introducing trading bot model in Automated Trading Specifications, and given historical data from [EthGasStation](#) we show, that automated part can be facilitated on Ethereum as well. The other bonus of liquidity pools is seamless new ERC20 token integration. The initial liquidity deposit could be created there from ICO funds lock or other income streams discussed further in details in **3.2 Incentives** section.

The collected data could be unambiguously analysed by oracle-like smart contract based on rules approved by review board (consisting of academia with different views on the subject and incentivised to participate as described in **3.2 Incentives** section) and outcomes could be fed to prediction markets like Gnosis, that will outsource everything related to distribution of results and prediction market UI and heat up the

interest to the contest, in turn leading to wider participation and broader statistics, deepening liquidity pool for contest token trading.

All participating accounts can be surveyed to be fit into different categories based on their age, sex, academical and work background etc, trading strategies and preferences. The validity and honesty of the survey can be enforced by process similar to KYC routines. But more appropriate seems to base the quality of the survey according to statistical findings from sociological research. Skeptics will bet that statistical data, collected during the contest, will have homogeneous distribution across all categories of participants of opposite camp. Basically they will bet on premise that every trading group has same (poor) mean performance just like anybody have same chances of guessing the dice being thrown, regardless of their background and experience. Thus ultimately proving market efficiency. Other groups will bet on assumption that their trading strategy and tools are winning. In details it will be discussed in the **3.2 Incentives** section further below.

In addition to free market - the idea to distinguish trader reaction to truly random events can be implemented via smart contract that will randomly buy/sell random significant volume of tokens. Reaction of traders to those spontaneous events should probably differ from reaction to patterns in price charts, if such patterns really do exist. Such feature can be discussed by the board, and implemented if necessary.

3.1 Resolution rules draft proposal

Outcomes of data analysis can be decided by smart contract in a yes/no fashion based on broad participant categories and detecting abnormal patterns above common statistical significance threshold of 5% or other value decided by board and approved by community. Based on decision of oracle - funds accumulated from sources proposed in **3.2 Incentives** section would be distributed by smart contract to the token

holder addresses proportionally to the amounts hold/obtained. Additionally prediction market would be resolved and the funds would be distributed as well.

3.2 Incentives

Participants of all groups would be incentivised. Skeptics will be primary ICO target group. Crowbar ERC20 token(CWBR) will be generated based on the amount of funds accumulated during ICO and released immediately to participate. It will form the prize for traders group. But in order to obtain funds locked during ICO - traders will have to purchase the token from holders (skeptics) thus driving the price up. For example if there will be the only trader who purchased only one token - it will generate data abnormality and oracle will decide that skeptics lost the bet, rendering all their tokens useless and distributing funds to the winning trading group. This will incentivise more and more traders to join as the bet is decided. But in order to get the tokens - they will have to drive the price further up. This will incentivise more and more holders to sell as they are effectively holding tokens of a lost bet. Skeptics are incentivised to not hold the tokens forever as the maximum return would be less or equal than the amount of funds invested into ICO. The CWBR token on the other hand - clearly does not follow a security definition, thus fits well to be placed on big exchanges driving the speculative interest and price up and therefore producing more statistical data. With those incentives - it is assumed that the active trading will start quite quickly and the price will reach its equilibrium soon after the contest start.

Contest is immune to manipulation as to produce statistical disturbance would be more costly than the amount of supposed benefit. One can try to manipulate the price by doing large transactions on external exchanges outside of data collecting smart contract, but in order to do so - one will have to purchase tokens from participants thus sharing the supposed benefit with one's group, making required input much bigger than supposed benefit. If one will try to manipulate statistics via smart contract - it will

be obvious to community, with immediate action possible ranging from requisition of funds, to contest restart with full penalty to a cheater. Data collection would be incentivised for traders by requirement to interact strictly via smart contract in order to have obtained tokens be converted to locked funds after contest resolution. Again - the only benefit of trading bypassing smart contract is speculation, in case of attempt to corrupt the test by distorting statistics(only via smart contract) - community can vote to cancel, heavily penalizing attacker that will get useless tokens and undecided oracle in return for substantial funds. Possible attack vectors will be discussed in more details in a section below.

3.3 Possible attack vectors

Definitions

Attacker - person, group or entity that aims to manipulate or corrupt the test. There may be at least three main types of motives for an attacker - financial, behavioral and/or academical. And various combinations of those. **Financial motive(FM)** doesn't require further explanation - manipulation for financial gains. **Behavioral motive(BM)** - is a type of motive, where the sole purpose of attack is to corrupt the test. **Academical motive(AM)** - is a type of motive, that aims to manipulate the test in such a way, that it will allow an attacker to support his claims and/or views.

3.3.1 Statistics manipulation attempt inside one of traders camp

FM - To obtain tokens - attacker will have to compete with a free market. In order for the data to be included in resolution calculation, attacker will further have to pass all transactions via logging smart contract, otherwise data will be not accounted. This will make him effectively one of traders so regular participant. In case such activity will produce sufficient statistical disturbance to disrupt a test resolution, winning camp

indicator could attract more traders, so that price of a token will come to equilibrium, thus nullify attacker's efforts and making his supposed gains zero at best.

AM - For academical motives, zero or negative financial gains could be not a stopping factor. But for this type of attack - lack of exposure is necessary. Requirement for passing transactions through smart contract will make manipulation attempt easily detectable by community and the board, thus it can be for attacker at best declared canceled and attacker exposed. Since tokens should be obtained on free market, this attack will drive the price up thus making it a costly manipulation attempt.

BM - This attack motive doesn't have any requirement, but protection can be similar as with AM - high cost.

3.3.2 Test corruption

FM, AM - Possible motives - participation in a losing camp

BM - Corruption as a sole motive

For all those motives, the securement of components of the test framework is a stopping factor. A security audit of the framework should be concluded by community, board and an expert entity, decided by the board and/or community.

3.3.3 Attack on consensus

AM - Only academical motive seems dominant here. Attacker could disrupt the board - to corrupt establishment of consensus. The protection from this attack can be formal definition of voting rules and bigger board size of 4 members and up. The 60% passing requirement and broad representation can be sufficient. Also safe test cancellation can be ensured by 60% vote requirement of board and each camp of participants. So that if for example skeptics or traders camp is determined to lose and they comprise more than 60% of participants, they can't cancel.

3.3.4 Statistics manipulation attempt between both trader's camps

AM, FM - In case of proposed test, attacker can attempt to interact through UI and API sides. Attacker will have to produce financial gains anyway to be conducted/accounted by smart contract. Since any existing software system isn't conscious - the attempt to manipulate outcomes by manual trading via API could be treated as software assisted trading(SAT), as well as any other automated system - thus having no impact on statistics and resolution.

3.3.5 Chasing winning camp.

FM - there may be attempt to switch to winning camp by chasing the winning side right before the test resolution.

3.3.5.1 Skeptics win.

Attacker can obtain tokens by registering as a skeptic, move the tokens to trading account and if traders will be deemed to lose - move his tokens back to his address, registered to a skeptic group. In order to prevent this type of attack - the amount of tokens eligible for payout on test resolution in the case of skeptics win would be an amount of unmoved tokens sitting on a skeptik account after start of a test. Each amount moved out of sceptics address will decrease the amount eligible for payout in case of sceptics win. Decreased amount will be recorded and will be set as eligible amount. Tokens sitting in all other addresses would be considered as trading amounts. And amounts that are sitting on accounts of skeptics that exceed the eligible amount would be simply burned - ie not included in funds distribution for payout, unless a cancel. This has some implications as skeptiks won't be able to join the test after it started. But if somebody would like to make a bet - it always will be possible to do on

a prediction market that Project Crowbar oracle-plugin would be made for without implications for the ongoing test itself.

3.3.5.2 Traders win.

On a test resolution in case skeptics lose - they immediately will be incentivised to sell all the amount of tokens on any price, greater than zero. The solution to this would be to stop the contest and halt all trading transactions immediately, once there is sufficient amount of data and/or predefined time frame reached. However this solution would imply that conditions and/or moment of test resolution have to be somehow opaque, that is quite neither doable, nor desirable. Let's assume that there is qualified agent, that is both proficient and capable of frankly informing community regarding outcomes and timeframes of contest. We can only assume that the reaction of community, according to empirical evidence on similar events, wouldn't be 100% rational. But to harden the task of predicting the exact moment of resolution we can bind the time frame to some on-chain values, like Ethereum block number, moment of statistical spike sufficient to decide outcome based on board consensus plus some tail timeframe based again on number of blocks variable. This is done to prevent distribution of accumulated funds to participants that will join the decided event shortly before outcomes and distribution snapshot, and to incentivise those participants, that contributed mostly to aggregation of statistical data. Shortly before the contest outcome is decided - the value of token will approach the amount of accumulated funds, divided by total amount of funds eligible for payout on contest distribution.

To fully incentivise traders, who accumulated tokens due to their hypothetical profitable trading strategies - the snapshot have to occur immediately on contest resolution and being not known to participants in advance. Since it's not the way to go, due to reasons described earlier - it can be assumed ideal value, asymptotically

approached by real snapshot. The selling price at this moment has to approach value of eligible payout. But since there will be large supply of tokens from skeptics, it will create high selling pressure both on order books and Bankor contract. There should be at least one trading cycle requirement (two transactions buy and sell) to prohibit new traders from joining (almost) decided event just to contribute statistically invaluable data and to downshift profits for established traders. So potential buyers would be only among traders eligible for payout. Because of that it will require of extra funding from their side in ETH, that will heavily limit buying capacity of supposed order book. On the other hand there will be large selling order volume. Only eligible traders with excess funding that also would like to improve their payout amount (supposedly with unsuccessful trading strategies that were not able to accumulate large amount of tokens during the course of test) would try to buy tokens at a price close to zero. On the other hand - skeptiks while incentivised to sell at any price higher than zero - still they will be selling tokens with a predictable value to buyers. So skeptics as well as uncertain traders may be trying to keep selling price close to the value of payout once all buying orders are filled. There may be two possible probable scenarios - occasional buying orders with very low price immediately filled by huge selling cloud. Or small buying orders depth with very low price and big selling orders depth and price close to payout value on the lower side. The second scenario will create huge spread, occasionally penetrated by 'weak hands' from both camps. In both cases the supposed trading volume would be neglectable. Also such trading on a asset with predictable upper bound value can provide valuable statistical data for the study and in a same time limit the dispersion of payout for eligible traders. Also halting of trading (and transactions from addresses other then payout address) can be anchored to a number of block when outcomes(winning side) of the test are decided and to condition if the price is below some very low threshold(4%) of payout value per token.

This scenario can assume that only late entry is incentivised for traders, but then it may mean that they will have to trade on undecided results with lower possible probability

of exit, as they may encounter situation when they will trade on token with decided winning for skeptics side.

For new traders that will try to play on decided event - trade cycle limit will imply that they will have to create at least three operations to be eligible for payout - buy, sell, and buy. When they will try to buy, they will contribute to buying order depth - pushing price up. Then they will have to sell at low buy order depth market pushing price down. And again buy, causing price to grow. And in the meantime trading can be halted once the lock condition will be hit. This requirement has to disincentivize such operations, must be performed by highly coordinated group and is extremely unlikely to succeed. Effectively this group will have to fight against free market as well.

4. Team



[Vitaliy Hnatyk](#) - exchange API and integration, smart contracts, research



[Yehor Hromadskyi](#) - smart contracts, API

5. Roadmap

Submission of early draft framework to Gnosis X contest

Crossplatform mobile/web/desktop wallet app with integrated trading function for manual traders

CWBR token ICO contract

Data collection on smart contract

Oracle and prediction market integration - base version of consensus to be improved by the board

Integration of exchanges for manual traders.

Prototypes of API for automated trading

6. Conclusion

The history of humanity is full of inventions and discoveries. Some of them play crucial role in progress of mankind, like vaccination, postulation of core physical laws, advances in math and theory of economics. And while in some areas there is immediate and indisputable outcome, others are not that lucky. Seems like medicine and economics are the most plagued by false promises and questionable improvements. And it's not that surprising.

If wealth is most common motivation of human activities, health is foundation and core resource for that. Yes, we all may have higher social and individual priorities ranging

from faith to survival. And yes - there are prominent people whose poor health conditions made them 'happy life' headlines. Like there are riches whose fortune made them heroes of sad narratives. But those are just exceptions to the rule that most common top personal benefits are health and wealth. Yet probably, this is not the main cause of medicine and economics being so vulnerable to questionable claims.

Common cause is that testing those claims requires much time and lots of sampling thus both become dependent on statistics. Approval of most usual drug takes decades and requires many patient cases. Study of financial laws, in turn, also spawns decades of observations of many price indices. And like if that wouldn't be enough, taking time-demanding aspect of the studies in those areas - both too often fall a victim of subjective and controversial interpretation ¹⁸⁾ of so costly acquired data. So costly because raw statistical numbers comprise not only cured, but also so many individual lives spoiled or even ruined by health and financial catastrophes of various scales.

It is a bit amazing, though, how health and finance areas are full of frameworks based on questionable beliefs. Just like an examples of modern day astrology - medicine hosts homeopathy, osteopathy and wide range of other pseudoscientific doctrines and practices. Similarly in economics - many frameworks of 'voodoo finance' like subjective technical analysis (STA) seems are 'feeling very well' among practitioners and to some degree even academia ³⁾. There are recent attempts to conduct Objective Technical Analysis (OTA) ⁴⁾ and these are divided in this paper to avoid prejudice. Some recent works ⁵⁾ of Andrew W. Lo, who with co-authors is among most-cited in the field, regards Technical Analysis (TA) as legitimate and useful discipline ⁵⁾. It's not so uncommon when people are discussing advanced software on an expert level and then switch to 'head', 'shoulder', 'bear' or even 'giraffe' and a bunch of other exotic creatures and shapes - so called "patterns" as an argument to support their point of view in context of trading strategies and algorithms.

The proposed framework, as authors see it, is nudge ²⁶⁾ to produce falsifiable and reliably resolve claims, theories and hypotheses in an unambiguous way. The concept of unbeatable efficient market sticks well with “wisdom of the crowd” theory, that prediction markets are based on, in the assumption that such a market is more efficient than any particular individual agent, that acts within.

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