OVERLAY

Being a brief description of the simple & elegant Overlay data trading system.

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Abstract

Overlay is a cryptocurrency that allows users to place bets on nearly any streaming data. It recreates the dynamics of trading, but without counterparties. Thus it completely solves the liquidity problems which beset similar systems like cash-settled futures, exchange and over-the-counter trading, and scalar prediction markets.

1 Introduction

Overlay is conceived as just that: an overlay on the preexisting world. It allows you to win (and lose) money on financial, political, natural, and social markets. Anywhere that data satisfying key characteristics is obtainable via the Internet, Overlay can be applied. In what follows, we will write OVL for the actual overlay token, which we distinguish from Overlay the system.

The idea behind Overlay is very simple. Using an oracle, any OVL holder can query a set of streaming data sources, such as the number of observed butterflies in the UK last year, the number of albums sold by an artist last month, the tons of steel exported from Australia yesterday, and so forth. Each distinct data stream is, for the OVL token, a market. Any fraction of an OVL token can be locked to a single market price by opening a virtual trade, which is a buy or a sell of a market at whatever value the oracle yields for the data stream. At a later time, the owner of those OVL can unlock them. The value of the data stream will be queried again, the difference in value between unlocking and locking time will be computed as a percentage return, and the original amount of locked OVL in the owner's wallet will be increased or decreased by that percentage.

> **OVL tokens are created and destroyed dynamically upon unlocking, and so a user's net OVL worth depends on the quality of virtual trades that user makes. The Overlay system emancipates the user from counterparties, and yet recreates the dynamics of trading itself.**

Note particularly that there is no ownership in the underlying. This eliminates many issues, and establishes Overlay as a unique financial derivative. An OVL position is closest to a futures contract that is operational on a spot basis. Investors use the futures because they don't want to hold the physical, but because they do not hold it there is no way for them to get the 'spot return'. Overlay solves this problem. Users get the spot return with no collateral, no mark to market, no bid ask spread, no commissions, no market impact costs, no storage costs, no transportation costs, no settlement costs, no illiquidity, no counterparty risk, no margin calls, no circuit breakers, no lending costs, and no short squeezes.

Example

You work in the manufacturing industry and are worried that a recession is imminent and your industry will be particularly hard hit. You would like some type of protection and the Conference Board's Consumer Confidence Index (CCI) is a natural measure that will vary with business conditions. Over its long history, the index has varied between roughly 150 to 20. Today's value is 133.4. The data are released at 10:00ET on the last Tuesday of the month.

You enter into a short position (which will profit when the CCI falls). The position requires OVL investment (suppose 1,000 OVL). If upon exiting the trade the CCI is at 50.4, then the profit on the position is (133.4-50.4)/133.4 = 62.219%. You receive 1622.19 OVL. If on exiting the CCI is at the level of 150.2, then the loss is (133.4-150.2)/133.4 = -12.594%. You receive 874.06 OVL

What about OVL risk?

A question that frequently arises at this point involves the fact that OVL works only if secondary markets allow users to redeem OVL for USD or something else. This setup creates currency risk and platform risk.

A user is exposed to currency risk if they mark their trade in USD and the price of OVL vs. USD falls during the course of a trade. We solve this problem by allowing users to specify their payout currency, such that their trade settles as though they entered it with that currency. If USD is the settlement currency and the price of OVL versus USD falls during the trade, the user would profit from this fall. It is a two way street, of course, since if the price of OVL rose versus USD, the trader would be worse off. Specifying a settlement currency is a second trade on the same OVL, and requires the payment of fees. Furthermore, the payout market, being just a market, can get crowded and become untradable (see bands in §2.1).

As this manner of hedging OVL risk is entirely novel, emerging organically from the main innovation of Overlay itself, it takes a little thought to fully take on board. We offer an example:

Suppose at the point of trade, 1 OVL = $1. We put $100 up to short CCI which is at 100. There is no hedge. One year later, CCI = 40. There is a profit of 60% which is 60 OVL. We now cash out 160 OVL. If the currency has not changed in value, then we get $160 and our dollar return is 60%. However, the currency could fluctuate. Suppose the exchange rate is actually 2 OVL= $1 at the time of liquidation. Here our 160 OVL = $80. Even though the OVL return was 60%, the dollar return is -20%. This is OVL risk. To hedge against this, we initiate a dollar-peg at the time of the contract. If OVL drops in value as above, then at liquidation of the contract, new OVL is printed so we get 320 OVL, not 160 OVL. This would ensure the 60% dollar return. Trading in this way is thus a two-sided peg. If OVL appreciates so that 0.5 OVL= $1. Then the 160 OVL would be worth $320 unhedged. However, if we pegged, we would only get 80 OVL of your original 100. Then the 80 OVL guarantees the $160.

USD Hedge	Entry 1 OVL	Exit 1 OVL	OVL Return	USD Return
No	$1	$1	60%	60%
Yes	$1	$1	60%	60%
No	$1	$2	60%	-20%
Yes	$1	$2	60%	60%
No	$1	$.5	60%	120%
Yes	$1	$.5	60%	60%

Another consequence of this hedging facility is that OVL becomes more attractive for global payments. A merchant in China might accept 1000 RNB worth of OVL, in the form of OVL locked to RNB with a RNB payout. This merchant is not exposed to the volatility of OVL, and has the 1000 RNB (minus small trading fees incurred when actualy exchanging the OVL for RNB) assured. The same merchant can pay for goods in Europe with the same OVL, after unlocking the RNB trade and locking to EUR.

The platform risk is more fundamental, and involves the necessity of liquidity. If there are no buyers of OVL, then users cannot get out of OVL, and the system fails. If users of OVL suspect that liquidity might dry up, this could cause a rush for the exit and a self-fulfilling prophecy. We solve this problem in two ways. First, we implement a monetary policy that reassures the market by capping the maximum currency supply. Second, the Overlay Foundation will work closely with multiple independent market makers, on multiple exchanges, to support the OVL/BTC, OVL/ETH, OVL/DAI, and other markets. This will incentivize bidirectional trading and liquidity.

2 Architecture

The Overlay system itself has three main interlocking parts: the *Monetary Policy* defined by the smart contracts which manage the currency supply, the *Suitable Data* which users can query and trade; and *Market Liquidity*, which allows users to redeem OVL for other currencies.

2.1 Monetary Policy

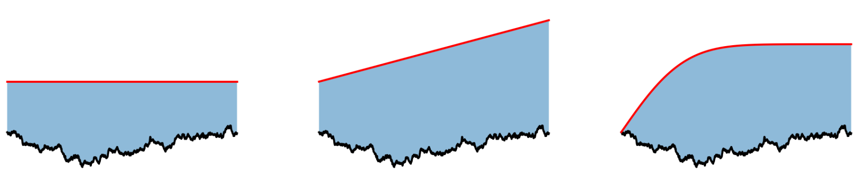
This is the most important single aspect of the entire Overlay concept. In solving the liquidity problem which prevents most data streams from being turned into cash-settled futures and scalar prediction markets, we have introduced an inflation problem. If all users get simultaneously and enormously lucky, one can imagine a situation in which the supply of OVL far outpaces the demand, leading to a decline in the price of OVL on the secondary market. This could result in a positive feedback loop.

Caps

The solution to this problem is caps. Let the *current supply* to be the number of OVL in existence at some time, and the *max supply* to be the maximum number of OVL allowed to exist at the same time. The current supply can never exceed the max supply, and we define the *liquidity pool*:

$$\text{liquidity pool} = \text{max supply} - \text{current supply}$$

The pool is the total number of OVL that users on aggregate can print at a given time. The max supply is itself a parameter that could be dynamic, or static. Below are three posssible models for the max supply, which is the red line. The black line is the current supply and the pool is the blue fill:



For now we assume a constant supply for simplicity. We will define a number of *bands* which will determine the risk level, and therefore the system parameters, including fees and local caps (see below). Roughly speaking:

When the risk is low (the currency supply is in the lowest bands) the fees can actually be negative, and the system can pay users out of inflation to take positions. This is a powerful incentive that can drive network effects early on in the system.

The system also needs two types of *local caps*, which apply on a per-market and per-user basis. Each market will have its own cap and banding system similar to the above, which will assure that market-specific anomalies do not affect the system as a whole. These caps will be dynamic, to adapt to changing market conditions and popularity. The OVL/USD market, for example, may get very crowded as users hedge their OVL risk, and the bands will narrow, causing trading fees to rise. If this market hits its cap, no more OVL can be printed from it.

Similarly, each trader will have a *max bet* per market, and a *max payout* per bet. The first is necessary to prevent attacks on the pool from adversaries, and to assure that wealthy users are not able to pull a disproportionate amount of money from the pool. The max payout can be large, on the order of $10 \times$ max bet. It is there to prevent a user from wiping out the entire pool with a single black swan windfall.

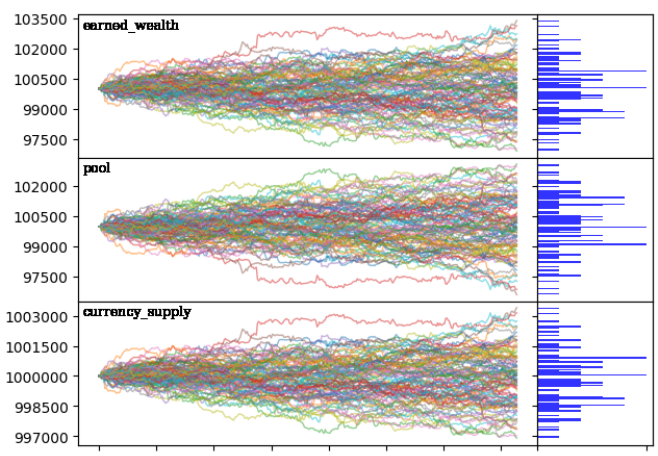
Caps certainly solve the inflation problem, but even if we assume moderate wins per trade, it is by no means obvious that the pool will still stay large enough. If the pool drops to zero and stays there, no users can redeem their positions, and it becomes unlikely then that they will enter new positions. The problem now becomes one of maintaining the pool. Interestingly, we have now come full circle, because this is a liquidity problem, though of quite a different and more tractable sort than the original one that affects futures and prediction markets.

Fees

In fact, it is quite surprising that dynamic fees solve this problem. In order to show this, we explore an agent-based model with the following basic setup.

A single market has a random price difference at each time step, sampled from a standard normal distribution. Also at each time step, traders flip a coin to decide if they will trade or not, and if they trade they take a random side. They always commit all of their capital. Wins are taken out of the pool and losses go into it. This model is less stupid than it seems at first because we can easily simulate trader luck or skill by skewing the mean of the distribution so prices trend up, and at the same time making traders more likely to go long.

We examine 100 traders, each with 1000 OVL each, and run the simulation for 365 steps (imagining traders have a daily frequency). Because we are interested in statistical features of this model, we do 100 runs of each simulation.[1] The results are quite expected.



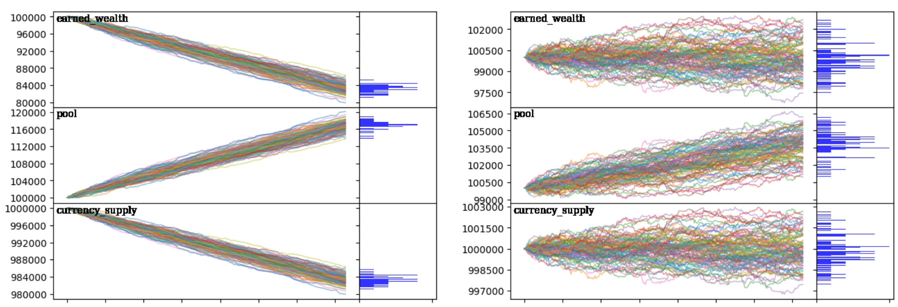
Each line in the top graph is the sum of all trader wealth, per run. As there are 100 traders with 1000 OVL each, this starts at 100,000 for all runs. As there are 100 runs, there are 100 lines. The middle and bottom graphs are the pool and the currency supply, respectively, per run. When

[1] The market they are trading, per time step, starts at 10000 and is sampled from a normal distribution with a mean of zero and a standard deviation of about 100. For example, one particular run is described by the statistics:

count	365	mean	18.7	std	123
min	-430.3	max	370.2	50%ile	23.1

the earned wealth goes up (users as a whole are winning), the currency supply goes up and the pool goes down. The charts to the right are shifted histograms of the outcomes. Because everything about this model is either a normal or uniform distribution, the outcomes are normally distributed. The average outcome is just the initial state, with extreme outcomes of about $\pm 3\%$ difference in the pool after one year.

Changing the parameters of this model reveals some interesting features. When the system charges very moderate fees of 10 basis points (.1%) per trade, this introduces an enormous skew into the outcomes. This is shown in figure 1a. Moreover, if we have zero fees but let the max supply grow linearly by 10 OVL per day, this will decouple the pool from the currency supply. This is shown in figure 1b.



(a) Fees of .1% per trade (b) Issue 10 OVL per day to max supply

Figure 1: Two independent runs with different parameters

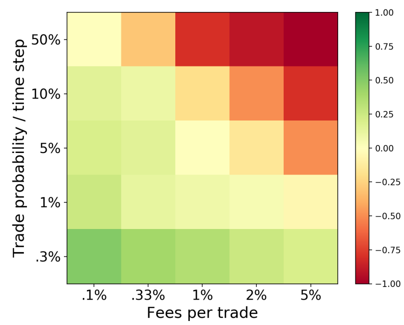
The higher the trading frequency, the more effective fees are. As shown above, traders with a 50% chance of trading all capital per day can easily be handled with small fees. If users trade less frequently, fees are less effective and trader performance affects the pool more. What happens when low frequency traders are on a winning streak?

To explore this question, we set up a model in which the price trends strongly up, and traders *only* go long. It is therefore almost guaranteed that traders will make money. We then map their percentage gains after a year[2] for various parameters of trade frequency and fees.

In the heatmap, the color represents the mean percentage gain in earned wealth of all traders, where the mean is taken over 100 runs. High frequency

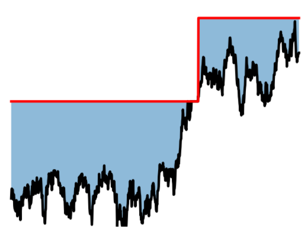
[2]The model is run for 365 steps in all cases except the lowest frequency traders, in which case the model is run for 1000 steps. Those traders trade, on average, once per year, and so more than one year is required to capture the dynamics.

traders (who trade once every two days on average) lose all of their capital in one year with fees at 5%, and break even with fees at .1%. Those who trade once per year on average are not affected to the same degree by fees.



The model suggests a few conclusions: first, if the system has only low frequency traders who win, there is little hope long-term for sustaining the pool. This, of course, is extremely unlikely to occur for long enough to threaten the system. If the system had both high and low frequency traders who were all winning, with fees at (an admittely high) 1%, the high frequency traders pay for the low frequency traders. Finally, this suggests that a simple, small, *per-day* fee could address all of these cases. Users do not mind paying reasonable fees for convenience, especially if they cannot get the service anywhere else.

The effect of fees outlined above addresses one of the basic risks of the Overlay system, The upshot is that the correct fee structure can address the problem of risks to the system, and this is in the absence of any change to the max supply. We propose a model which adds to the max supply only in a crisis. That is, the max supply can be constant except when the fee solution somehow breaks down and the pool falls to zero. In such cases there would be an addition to the max supply by perhaps 1%, with an upper annual inflation held to the CPI inflation (roughly 3%).



2.2 Suitable Data

The primary innovation of Overlay is that streaming data regardless of origin can be turned into an investment vehicle. Any data stream that could possibly be traded with OVL we will call *suitable*. To be suitable, it is necessary for all data to be reliable and stable,[3] and also to stream: i.e. it must also be queryable at regular time intervals.[4] Data streams must also be *non-manipulable* and *unpredictable*.[5]

Once these simple conditions are met, it is fair game.[6] There are hundreds if not thousands of suitable streams which could be added to Overlay in the first year, and which would be completely unique markets, not tradable anywhere else. Because Overlay has such a unique niche out of the gate, we propose to focus on this value-proposition exclusively, until it becomes clear that Overlay is working and it may be worth branching out. Some data streams which we are excited to see become markets are:

- *Currencies.* Overlay should have all major fiat currencies as markets. This allows users to hedge OVL against a local currency, and send payments without volatility risk.
- *Niche Markets.* Overlay excels in offering niche markets with specialized interest. World of Warcraft subscribers, US drone strikes per week, the number of housing foreclosures, author book sales.
- *Indices.* New indices can be constructed endlessly. A CryptoVIX could be very interesting. Other possibilites are indices tracking shoe prices,[7] art prices at auction, etc.
- *Portfolios.* Overlay markets can be combined permissionlessly into new instruments. This allows users to construct portfolios and post them, and for other users to lock assets to them.

[3]Stable means a data stream has a constant update frequency. Data aggregation (say of album sales from different countries) can pose difficulties when the frequencies do not match, but these are not insuperable so long as the frequencies themselves do not change.

[4]Note that delayed data is okay, so long as the delay is known. Any bets placed on a delayed stream would themselves be delayed by the same amount of time.

[5]Prediction is a complicated concept. Here 'unpredictable' means not easy to predict.

[6]Because data streams need to be suitable, data needs to be curated by the token holders. Thus markets will be added (and removed) through governance. See §3 on this.

[7]These are extremely volatile, see stockx.com.

Because there is more data in the world than anyone knows, the Overlay Foundation will have a way for anyone to suggest a new stream. Some data that seems *a priori* suitable includes: All global price data of all financial markets: spot, futures and options, all cryptocurrencies, niche OTC contracts, etc. Economic data such as Non-Farm Payroll numbers, CPI, Inflation, ZEW. Alternative economic data such as the number of Teslas sold daily, the number of housing foreclosures, the tons of steel exported by Australia. Data on the Overlay system itself: number of open positions, amount of locked OVL. POS prices such as the Economist Big Mac index. Social data like crime and census rates. Sports records data. Game currencies like Linden Dollars, World of Warcraft gold. Natural data like inches of rain, average wind speed. Disaster data like cost per nation per year of hurricanes, earthquakes. Artistic data like album and book sales. Etc...

2.3 Market Liquidity

In order for Overlay to be interesting and useful, users must be able to sell their OVL for BTC, USD, or some other currency. So long as such means of exchange exist, Overlay can play its role as a universal trading platform.

The issue of liquidity, which contributes to the health of Overlay, actually assumes this health to start with. This means that positive feedback is possible and network effects will be observed as more people participate. It also means that when Overlay is young, such effects will not be observed and that bootstrapping will be required. It is reasonable to assume that OVL will be a highly liquid token. There are several reasons to expect network effects to materialize:

- OVL is the only way to participate in certain non-markets.
- OVL is a convenient way to participate in illiquid markets.
- The Overlay Foundation will strongly incentivize liquidity solutions.

These first two reasons are the main selling points of Overlay, and it is easy to see how network effects will emerge if Overlay begins operating as a pooled liquidity vehicle for both non-markets and illiquid assets. In this way, OVL aggregates all the liquidity of all trades and markets into a single pool. Even if the interest in each market is small, with enough markets the interest in the token becomes large.

3 Oracles, Keepers & Governance

The data values will be fed to the blockchain via oracles. To begin, Overlay will recreate the oracle architecture used by MakerDAO to track USD/ETH. For each particular data feed there will be at least a dozen individual oracles, each having control of a single price feed contract. Every oracle will have a price value and an expiry period, probably updated at a daily frequency to start. (High frequency data introduces many difficulties.) The oracle queries several times per expiry period, and the contract updates when the price varies a certain percentage or is close to expiring.

Overlay will also have a medianizing contract which takes all oracles for a given feed and calculates their median. If at least half are valid, the Medianizer updates its price. It may also be desirable to implement MakerDAO's Oracle Security Module, which reads from the Medianizer and queues up its price every hour on the hour. The OSM has a one hour delay, allowing a reasonable amount of time to respond if the oracles are attacked.

Keepers are another important feature, because it is not possible to have the Overlay system automatically burn a user's offside positions without paying oracles. Keepers are permissionless contracts which scan the blockchain looking for underwater positions. If one is found, it is liquidated, and the Keeper earns a percentage of the burned funds. The details will be up to the token holders, but a plausible setup would be that in low and medium risk regimes the Keepers are on pause, but in high risk regimes when the liquidity pool is too low, the Keepers would be set free to hunt.

As data sources need to be curated, governance is critical for Overlay's long-term success. Again we take cues from MakerDAO, as it has similar governance needs to Overlay (i.e. continuously curating a list of reliable feed providers and finding consensus on product offerings). The MakerDAO team uses the DS-Chief module of Dappsys to serve as the authority of their contract system, which in turn empowers the MKR holders to elect another contract that receives root access permission into the system using approval voting. This root contract can then offer its own unique business logic to address the community's governance requirements over time. In this way the DS-Chief module represents a continuously editable constitution. It can set and reset the rules of a smart contract system's authorization layer according to the will of a staked token holding community.

4 Conclusion

Like an organism from a single cell, Overlay is based on a simple idea which unfolds into a beautiful and complex system. Some consequences are:

- Overlay solves liquidity problems. Most data sources are not tradable, either on a futures market or a prediction market, because sellers and buyers must be matched. Significant trader interest must already exist to make such markets tradable, and so very few of the possible markets are ever created.

- As a consequence of the previous point, a mature Overlay market would encompass the world and be a competitor to anything that is exchange or OTC traded.

- The Overlay system can easily set fees negative, thus paying users to trade and providing a powerful incentive to attract users in the early days and drive network effects. These negative fees can also be offered whenever the system can afford to offer promotions.

- Global data sources and interest in monetizing data will continue to grow, with no end in sight. Overlay has enormous potential to serve as a go-to platform which offers investors, hedgers, and speculators exposure to financial instruments they cannot get anywhere else.

- The ability to hedge OVL trades makes it unique among cryptocurrencies, and quite attractive for cross-currency payments. OVL is a mutable, protean currency which resembles an actual trading platform, rather than any single form of money.

- Because there are no counterparties, there is no price impact. Any OVL trade, of any amount, settles at a single price.

A system which recreates the dynamics of trading and yet is emancipated from counterparties solves a surprising number of problems in finance. We are excited for the future of Overlay and invite you to join us in creating a platform that expands the financial world by multiple orders of magnitude.