ARMADILLO

DECENTRALIZED IMPERMANENT LOSS PROTECTION SYSTEM

powered by The Crypto Volatility Index CVI

White Paper

By:

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1. Abstract

The Crypto Volatility Index (CVI) is a VIX for crypto. The index was created by the COTI team that has partnered with Professor Dan Galai, the creator of the original VIX, in order to create a “market fear index” for the crypto market. The CVI was created using the Black-Scholes option pricing model, and it computes the implied volatility of BTC and ETH option prices while analyzing the market’s expectation of future volatility. At its core, the CVI owns and operates a basket of volatility products, including impermanent loss protection, which is one of its most promising solutions for today’s liquidity providers.

Users can simply purchase a custom impermanent loss protection, specify the length of coverage and they will be fully protected against a set amount of impermanent losses. By doing so, users will be able to maxi-mize the benefits that come with providing liquidity, while hedging themselves against impermanent loss that could occur from future volatility. The users can choose between 14, 30, and 60 days of protection. The smart contract will then calculate the premium based on variables such as the tokens’ price at the time of purchase and the expected implied volatility using the CVI calculations.

By using Armadillo’s impermanent loss protection, users are able to supply liquidity safely in any chain, DEX, or platform. The users do not need to stake their LP tokens in order to purchase the Armadillo impermanent loss protection.

2. Introduction

2.1 Impermanent loss explanation

Impermanent loss is a decentralized finance (DeFi) phenomenon that occurs when an automated market maker’s (AMMs) algorithm driven token rebalancing formula creates a divergence between the price of an asset within a liquidity pool and the price of that same asset outside of it. Even after prices converge as time goes by, loss occurs due to the change in the rate between Liquidity Providing entry and exit times.

In essence, impermanent loss is a temporary loss of value that occurs when providing liquidity. It will however become effectively permanent the moment liquidity is drawn from its pool. It’s often explained as the difference between holding an asset versus providing liquidity to that asset. Impermanent loss is usually observed in the most standard and common liquidity pools, to which the liquidity provider (LP) has to provide both assets in a correct ratio and of which one is volatile in relation to the other.

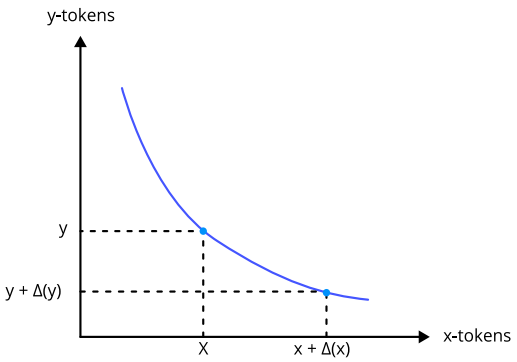

Figure 1

Most AMM and liquidity pools use the constant product formula as such:

$$1)\ x * y = k$$

This is the formula that mathematically determines what the market price of the token in the pool should be. **x** and **y** represent the respective balance of a pair of tokens, and **k** is a constant that will never change.

The Impermanent loss is defined by the formula:

$$2)\ IL(S) = \frac{2\sqrt{r}}{(1+r)} - 1$$

In this formula, the variable refers to the ratio change from the initial price to the future price. For example, if an asset valued at 1 increase by 10%, it would have a value of 1.1. Once you have the value of impermanent loss for the given change, you can multiply that percentage by the initial value to get the actual USD amount.

As we can see in figure 2, an impermanent loss is inevitable when using automated market makers like a liquidity pool. It decreases your gains and can dramatically increase your losses.

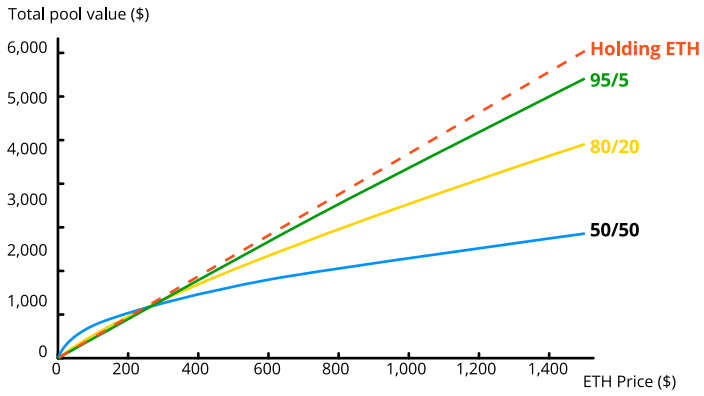

Figure 2

2.2 CVI index and its correlation with impermanent loss

In a nutshell, the CVI index is produced based on a Black-Scholes option pricing model, which computes the implied volatility of BTC & ETH option prices and analyzes the market's expectation of future volatility.

The CVI index is calculated based on exchange-traded 30-day option prices. The options are then used to calculate a classic VIX-formula index; these options are traded at widely adopted exchanges, with sufficient turnover, and with market makers responsible for providing quotes for all traded options. Also, CVI calculations require that a future market exists for the underlying asset, preferably at the same exchange. We use data from major and reliable sources for the initial CVI calculations.

In a volatile marketplace, impermanent loss is almost guaranteed when staking cryptocurrency assets within a standard liquidity pool. Impermanent loss occurs no matter which direction the tokens prices go (for a token trending upward, impermanent loss represents an opportunity cost). The more the tokens diverge, the greater the impact of the impermanent loss.

Therefore, the level of the CVI index is a good indicator for the expected impermanent loss that will occur from future market volatility (as shown in figure 3).

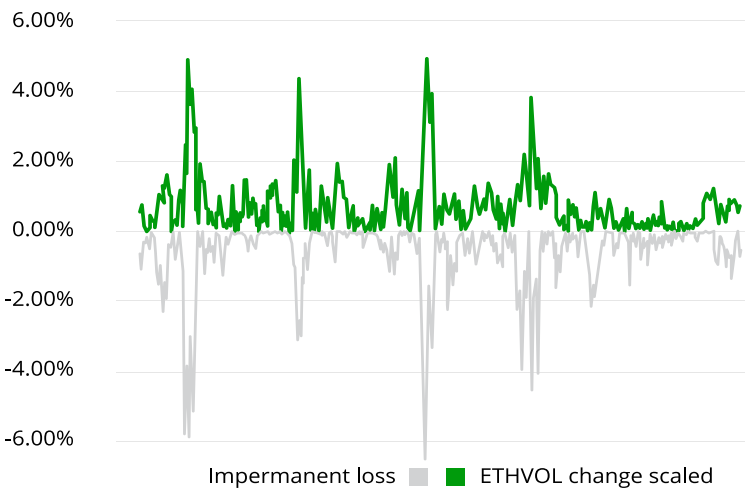

Figure 3

In figure 4 we can see the average IL according to every level of the CVI index in ETH-USDC 50:50 ratio liquidity pool for the past 3 years:

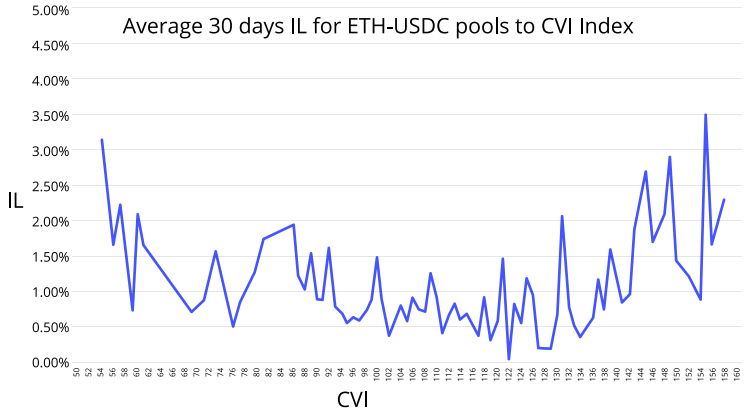

Figure 4

The effect of the curve can be explained by the following:

When the volatility index is **low**, we can expect stable growth of the ETH price, which concludes in a **high** IL percentage.

When the volatility index is **high**, we can expect a volatility in the ETH price, which concludes in a **high** IL percentage.

When the index is at its average, we can expect a sideways trend and relatively low IL percentage.

3. Impermanent loss protection calculation:

We define the dependency between CVI and the expected IL percentage for the next 14,30 and 60 days as a simple quadratic parabola fitted to the historical data.

$$Impermanent\ loss\ protection\ price = (a * (Xt - Xo)^2 + C) * P$$

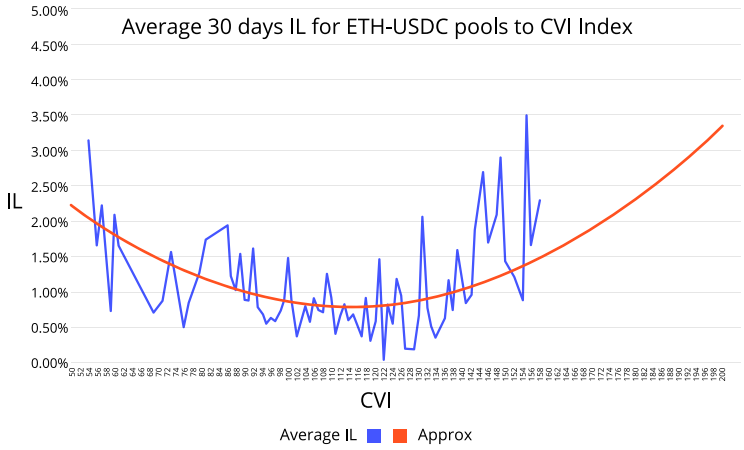

Figure 5

Where

a - Stands for the coefficient of the fitted model and describes the quadratic parabola slope.

Xt - Stands for the level of CVI at the time of IL protection purchase.

Xo - Stands for the level of CVI at the lowest expected IL percentage.

C - Stands for the IL percentage relative to X0.

Figure 6 shows us the value of variant C versus the mean IL percentage for 30 days periods. If we refit the parabola approximation to half-year periods keeping the a and X0 parameters fixed, we can see a clear linear dependency while the red point represents the entire period. The calculation of C is done separately for 14,30 and 60 days.

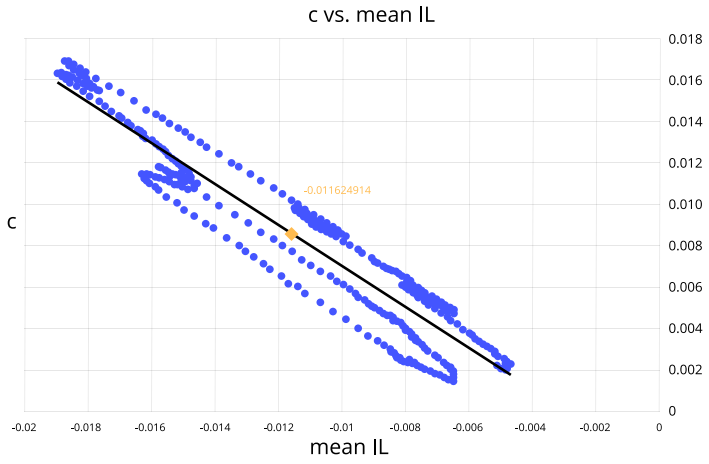

Figure 6

P - Stands for the premium charged, calculated according to the collateral ratio, this variant is designed to create an equilibrium between the liquidity pool value that is provided to the IL protection and the value covered by the IL protection. For example:

We defined at 15% the max IL protection cap, which covers up to 99.7% of IL percentage according to historical data. Therefore, the maximum value the liquidity pool can protect is:

$$maxIL = 15\%$$

$$-\frac{V_1 - V_{held}}{V_{held}} = 1 - 2\frac{\sqrt{r}}{r+1} \leq 0.15$$

$$(r + 1) - 2\sqrt{r} \leq 0.15\,(r + 1)$$

$$r + 1 - 2\sqrt{r} \leq 0.15r + 0.15r$$

$$0.85 \leq 2\sqrt{r} - 0.85r$$

$$r \in \left(\frac{511 - 40\sqrt{111}}{289} , \frac{511 + 40\sqrt{111}}{289} \right) = (0.3, 3.22)$$

Thus, when checking for the adjusted rate:

$$- \frac{V_1 - V_{held}}{V_0} = \frac{(2\sqrt{r} - r - 1)}{2} = \frac{1 + r - 2\sqrt{r}}{2}$$

$$\text{adjusted } r \leq 0.1022, \text{ adjusted } r \geq 0.3155$$

Then:

$$\text{max protection value} = \frac{1}{r} * \text{liquidity pool} \approx 3.1696 * \text{liquidity pool}$$

Therefor:

$$P = e^{\frac{\text{amount to protect}}{\text{liquidity pool} * 3.1696}}$$

In a given $2,000,000 liquidity pool we can see that:

Liquidity	Amount to protect	P
$2,000,000	$50,000	1.007919
$2,000,000	$100,000	1.0159
$2,000,000	$200,000	1.032053
$2,000,000	$300,000	1.048462
$2,000,000	$400,000	1.065133
$2,000,000	$500,000	1.082068
$2,000,000	$600,000	1.099273
$2,000,000	$700,000	1.116752
$2,000,000	$800,000	1.134508
$2,000,000	$900,000	1.152546
$2,000,000	$1,000,000	1.170872
$2,000,000	$2,000,000	1.370941
$2,000,000	$3,000,000	1.605196
$2,000,000	$4,000,000	1.879479
$2,000,000	$5,000,000	2.200629
$2,000,000	$6,000,000	2.576654

Figure 7 displays the exponential growth of P, which was created as an incentive for the IL protection buyers to acquire the protection when the collateral ratio is low, and an incentive for the liquidity providers to add liquidity when the collateral ratio is high.

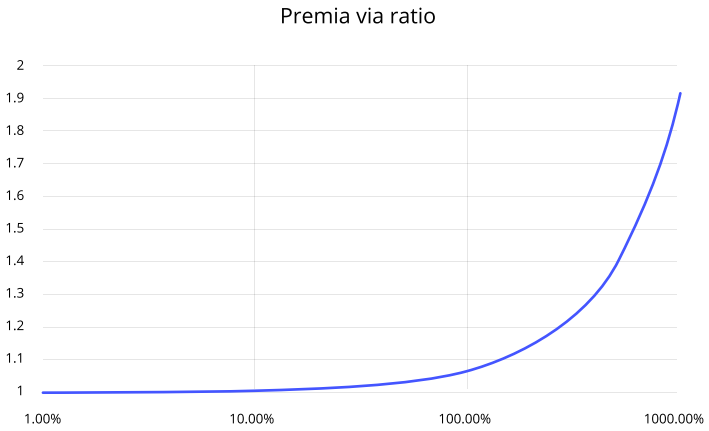

Figure 7

4. How does Impermanent loss protection work?

The system will calculate the correct values of the variants based on the historical data for each period, as well as their exact value at the time of purchase, which it will multiply by the quadratic parabola.

The quadratic parabola reproduces a value from a prediction model based on historical data and on the CVI level of the reasonable price of protection. The definitive price will be corrected for the supply/demand balance.

Using our proprietary model, any impermanent loss protection purchased will be reflected as an NFT that represents the coverage value. The appropriate time frame, and the pair selected by the user. Through this, any impermanent loss incurred will be automatically refunded to the user's wallet for that time duration in a seamless and secure manner.

When the protection period expires, Armadillo will automatically refund all of the realized IL that occurred due to price changes in the LP tokens.

5. Future development

- IL Protection for a variety of pairs - CVI tracks the implied volatility of BTC and ETH option prices and them only. Once the trading volume of options on other tokens increases in centralized and decentralized Futures exchanges, we will add them to our CVI Index calculation, which will allow us to give a more precise estimation of their IL.
- Hedging liquidity by Long positions on the CVI index and opening more liquidity pools for users or dexs to actually be on the selling side.