Hedging Contracts in Ether

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Abstract

We build a platform to allow hedgers and speculators to meet and enter into hedging contracts. We first expose the hedging contract details and then, we explain our implementation. We investigate how our contracts could be extended in the future and how our platform could be improved to include more features and allow a smoother matching. Allowing hedging will improve the attractiveness of Ethereum as a medium of exchange, as merchants usually do not want to be exposed to the risk of exchange rate.

Keywords: Hedging, Ethereum, Smart Contracts, Blockchain

1 Introduction

We wanted to create smart contracts which can increase the potential of Ether as a medium of exchange. Merchants are not willing to hold bitcoins for example, as they are not willing to be exposed to the risk of exchange rate. For Bitcoins, this has created downward pressure on its value in terms of USD and has also propped up its volatility. Thus, we design hedging contracts in Ether, which will allow to hedge positions in Ether. As merchants will be more willing to hold Ether, the market capitalization will grow, which will attract more speculators. This, in turn, will make hedging easier.

The hedging contract, which we designed, enables to hedge a position up to a decrease of a certain percentage and an increase of a certain percentage. Out of this bandwidth, the contract will insure up to the maximum amount. In order to insure that contract participants will be able to meet their liabilities, the hedger and the speculator will have to lock in some amount of Ethers.

As payments can only occur in Esther, it is not completely possible to insure a position up to 100%: If the value of Esther would fall, the speculator would have to give the hedger an infinite amount of Esther to compensate, which cannot be committed up-front, as default is not possible in Ethereum.

2 Contract Details

The hedger wants to hedge a position of w Ethers, meaning that he wants to keep constant the value of his position in terms of USD.

The initial price of one Ether in USD in the contract is denoted by P_0. The value of the position is therefore $V_0 = wP_0$. The counterparty of the hedger in a hedging contract is called the speculator. The contract is as follows.

Parameters

- Amount of Ethers hedged w
- Amount of Ethers brought in the contract by the speculator w_s
- Maturity T
- Threshold low $b_L \in]0, 1[$

- Threshold high $b_H \in [1, +\infty[$

Contract Setup

We denote by $R := \frac{P_T}{P_0}$ the return on holding Ether between time $t = 0$ and $t = T$. We design in the following a contract such that

- if $R \in [b_L, b_H]$, the hedger makes neither gains nor losses,
- if $R \in]0, b_L[$, the hedger is insured up to the decrease b_L and makes losses for the difference $b_L - R$,
- if $R \in]b_H, \infty[$, the hedger is insured up to the increase b_H and gains from the difference $R - b_H$.

Time $t = 0$ – Time when the contract is accepted by the speculator

The hedger has to lock the highest amount he should be able to pay, i.e.

$$L_H = w\left(1 - \frac{1}{b_H}\right). \tag{1}$$

Similarly, the speculator has to lock

$$L_S = w\left(\frac{1}{b_L} - 1\right). \tag{2}$$

Time $t = T$ – Time when the contract reaches maturity

If the price of one unit of Ether in USD increases relative to its value in $t = 0$: $R = \frac{P_T}{P_0} > 1$, the hedger has to give to the speculator an amount

$$x_H = \min\left(w\left(1 - \frac{1}{R}\right), w\left(1 - \frac{1}{b_H}\right)\right). \tag{3}$$

If the price of one unit of Ether in USD decreases relative to its value in $t = 0$: $R = \frac{P_T}{P_0} < 1$, the speculator has to give to the hedger an amount

$$x_S = \min\left(w\left(\frac{1}{R} - 1\right), w\left(\frac{1}{b_L} - 1\right)\right). \tag{4}$$

Hedger's Position in USD

- If $1 \leq R \leq b_H$, the value of the hedger position in USD is then given by

$$wP_T - w\left(1 - \frac{1}{R}\right)P_T = wP_0. \tag{5}$$

- If $b_H < R$, the value of the hedger position in USD is then given by

$$wP_T - w\left(1 - \frac{1}{b_H}\right)P_T > wP_0. \tag{6}$$

  The right-hand side is in P_T.

- If $1 \geq R \geq b_L$, the value of the hedger position in USD is then given by

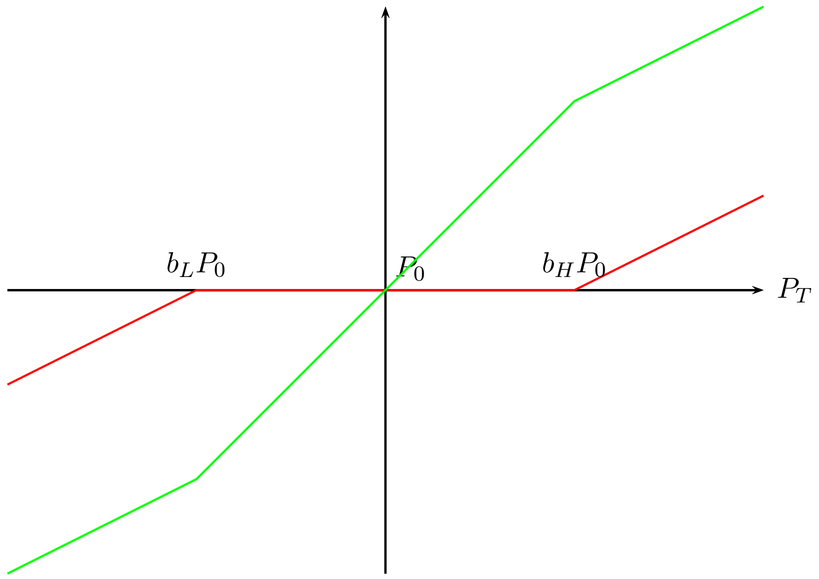
$$wP_T + w\left(\frac{1}{R} - 1\right)P_T = wP_0. \tag{7}$$

- If $b_L > R$, the value of the hedger position in USD is then given by

$$wP_T + w\left(\frac{1}{b_L} - 1\right)P_T < wP_0. \tag{8}$$

  The left-hand side is linear in P_T.

The hedger's payoff in USD is given in red as follows and the speculator's payoff in green:



Speculator's Payoff in USD

- If $1 \leq R \leq b_H$, the speculator's payoff in USD is then given by

$$w(P_T - P_0). \tag{9}$$

- If $b_H < R$, the speculator's payoff in USD is then given by

$$w\left(1 - \frac{1}{b_H}\right) P_T. \tag{10}$$

The right-hand side is in P_T.

- If $1 \geq R \geq b_L$, the speculator's payoff in USD is then given by

$$w(P_T - P_0). \tag{11}$$

- If $b_L > R$, the speculator's payoff in USD is then given by

$$-w\left(\frac{1}{b_L} - 1\right) P_T. \tag{12}$$

The left-hand side is linear in P_T.

3 An example

Let's imagine that $P_0 = 10$ USD per Ether and that the hedger has $w = 10$ Ethers to hedge. If the hedger wants to be insured up to a decrease of 50% and accepts that the speculator is rewarded up to an increase of 100%, this means that $b_L = 0.5$ and $b_H = 2$. Therefore, the hedger has to lock in

$$10\left(1 - \frac{1}{2}\right) = 5 \quad \text{Ethers.} \tag{13}$$

Similarly, the speculator has to lock

$$10\left(\frac{1}{0.5} - 1\right) = 10 \quad \text{Ethers.} \tag{14}$$

Let's imagine the following scenarios now.

The value of Ether decreases by 25% **to 7.5 USD per Ether** Then, the hedger receives from the speculator

$$\begin{aligned} x_S &= 10\left(\tfrac{1}{0.75} - 1\right) \\ &\approx 3.33 \quad \text{Ethers..} \end{aligned}$$

Then, the hedger's payoff is $13.33 * 7.5 = 100$ USD. The speculator looses $3.33 * 7.5 = 25$ USD.

The value of Ether increases by 25% **to 12.5 USD per Ether** Then, the speculator receives from the hedger

$$\begin{aligned} x_H &= 10\left(1 - \tfrac{1}{1.25}\right) \\ &= 2 \quad \text{Ethers.} \end{aligned}$$

Then, the hedger's payoff is $8 * 12.5 = 100$ USD. The speculator gains $2 * 12.5 = 25$ USD.

The value of Ether decreases by 75% **to 2.5 USD per Ether** Then, the hedger receives from the speculator

$$\begin{aligned} x_S &= 10\left(\tfrac{1}{0.5} - 1\right) \\ &\approx 10 \quad \text{Ethers..} \end{aligned}$$

Then, the hedger's payoff is $20 * 2.5 = 50$ USD. The speculator looses $10 * 2.5 = 25$ USD.

The value of Ether increases by 75% **to 17.5 USD per Ether** Then, the speculator receives from the hedger

$$\begin{aligned} x_H &= 10\left(1 - \tfrac{1}{1.5}\right) \\ &= 3.33 \quad \text{Ethers.} \end{aligned}$$

Then, the hedger's payoff is $6.67 * 17.5 = 116.7$ USD. The speculator gains $3.33 * 17.5 = 58.2$ USD.

4 Implementation Details

Problem with formula

$$x_H = \min\left(w\left(1 - \frac{1}{R}\right), w\left(1 - \frac{1}{b_H}\right)\right). \tag{15}$$

if threshold b_H is too high.

- While $original.blocktime + T > actual.blocktime$,

$$\begin{aligned}
hedger.lockedfunds &= w - \frac{w}{maxThreshold} \\
hedger.unlockedfunds &= \frac{w}{maxThreshold} \\
speculator.lockedfunds &= \frac{w}{minThreshold} - w \\
speculator.unlockedfunds &= w_s - \left(\frac{w}{minThreshold} - w\right)
\end{aligned}$$

- While $original.blocktime + T \leq actual.blocktime$,
  - if $P_T > P_0$,

$$\begin{aligned}
hedger.lockedfunds &= 0 \\
hedger.unlockedfunds &= w - \min\left(w - \frac{wP_0}{P_T}, w - \frac{w}{maxThreshold}\right) \\
speculator.lockedfunds &= 0 \\
speculator.unlockedfunds &= w_s + \min\left(w - \frac{wP_0}{P_T}, w - \frac{w}{maxThreshold}\right)
\end{aligned}$$

  - if $P_T < P_0$

$$\begin{aligned}
hedger.lockedfunds &= 0 \\
hedger.unlockedfunds &= w + \min\left(\frac{w}{minThreshold} - w, \frac{wP_0}{P_T} - w\right) \\
speculator.lockedfunds &= 0 \\
speculator.unlockedfunds &= w_s - \min\left(\frac{w}{minThreshold} - w, \frac{wP_0}{P_T} - w\right)
\end{aligned}$$

5 Front-end Platform

TO DO

6 Extensions and Conclusion

Hedging longer-maturity contracts should cost more to hedgers than short-maturity contracts. We could easily account for that in the future.

We should ensure that the volume of one contract is lower than the market volume in average. Otherwise, market manipulations could be feasible.

We could hedge in different currencies.

We could aggregate contracts to allow for a better match.

We could replicate financial markets in Ethereum and hedge the positions in Ethereum.