Casper FFG: CAPM & Validation Yield

Link to working doc

tl;dr

While the CAPM model and Sharpe ratio have major limitations, there are concrete takeaways for designing Casper incentivization. Primarily, the more we can limit the standard deviation of validation yield, the lower the required returns of the validators

. That allows for either lower issuance/dilution—or for any given level of issuance, a higher risk-adjusted return—which will make participation in the network more compelling for the same level of issuance.

Introduction to CAPM

$E(R_i) = R_f + \beta_i (R_m - R_f)$

$E(R_i) - R_f = \beta_i (R_m - R_f)$

In other words, the risk premium of a given asset (such as ETH validation stake) should be the (a) relative volatility of the asset vs the market times (b) the market premium of the asset.

- The risk premium ($E(R_i) - R_f$

) is defined as the expected return of the asset in excess of the risk-free rate (e.g. 3 month US Treasury bill)

- The beta of the asset (B_i

) is the standard deviation of the asset returns divided by the standard deviation of market returns (σ_i/σ_m

). This measures the relative volatility of the asset returns to the market.

- The excess market returns $R_m - R_f$

is the returns of a given “market” in excess of the risk-free return.

The two large factors for this analysis is:

1. What is the correct & reasonable selection of the relevant “market returns” that this asset class is under?
2. How the reward/penalty parameters will affect σ_i

and therefore the β_i

of the asset.

1. The more we can limit the standard deviation of the asset returns (make it more predictable, the less we have to reward the validators. i.e. less issuance / dilution of ether value. or higher excess return for same level of issuance).

To take it one step further: there are three real drivers of the assets required returns $E(R_i)$

. The required returns of the asset will be greater when:

1. The market returns are higher.
2. The standard deviation of the asset returns are higher.
3. The standard deviation of the market returns are lower.

Conclusion

The main takeaway here is that, there is a direct cost to ETH holders for having high standard deviation validator returns

. So for a given level of “economic security,” we should strive to minimize the standard deviation of validator returns. That will allow for (1) additional “resources” to increase penalties / cost of attack by increasing TD, (2) decreasing issuance and enhancing value of ETH, or (3) provide additional excess risk-adjusted returns to validators (attracting a broad set of validators).

Also related: Sharpe ratio and its cousin Sortino ratio