Sollar

Decentralized interest rate & fixed income protocol

Litepaper

v 1.1.0

February 2022

1. Motivation

Interest rate market is one of the most foundational building blocks of finance. As of January 2022 in decentralized finance, we observe most of the yield offered are in APYs which are paid out in risk assets, or are floating rates, or both. Furthermore, most Defi interest rates are not guaranteed. Based on the writer's knowledge, there does not exist a broadly adopted risk-free interest rate benchmark on which financial valuation can be based. Moreover, most of the collateral based lending products are quoted in floating interest rate with risk of pre-maturity collateral call (i.e. liquidation). This makes it difficult for hedgers, asset managers, and investors to price and manage their assets.

To tackle this issue, we propose the use of decentralized derivatives to create reliable synthetic fixed income products. For savers, a synthetic bond can be created through the use of the interest rate parity condition in which long asset, long European put, and short European call can produce a risk-free position, against which a bond can be issued. The saver earns a fixed rate of interest on his/her stablecoin assets through the bond. For borrowers, a synthetic loan can be created by creating a synthetic fiduciary call option: sell spot asset, buy call and sell put at the same strike and buy put at the LTV of the collateral, against the value of which the loan face value is determined . The loan is not callable prior to maturity because collateral is synthetic. Through option and spot asset positions, borrowers and savers can be assured of surety of the yield and interest payment. Borrowers do not have to worry about liquidation risk. Investors can rely on the yield they see. Through Sollar we hope to help investors and asset allocators better price and manage risk and liquidity in decentralized finance.

2. Version 1 Protocol Design

a. Bonds

Sollar protocol uses the put-call parity condition:

$$C_0 + X * e^{-r*t} = P_0 + S_0 \quad \text{(i)}$$

Rearranged to:

$$X * e^{-r*t} = P_0 + S_0 - C_0 \quad \text{(ii)}$$

Where:

X	Strike price of put and call option on underlying asset
e^{-r*t}	Continuous interest rate function with r as interest rate and t as duration
P_0	Put option with X as strike price and t as expiry
S_0	Underlying spot asset
C_0	Call option with X as strike price and t as expiry

Options are European-style options. Option expiry is effectively the maturity date of the bond.

Left side of the equation represents a synthetic bond with X as maturity value and t as time to maturity of the bond. Interest rate of the bond is represented by r. The right side of the equation is the synthetic bond's underlying asset positions. Users of Sollar would deposit stablecoin and choose a maturity date of their desire. The stablecoins are used to long a spot asset, sell a call, and buy a put of the same expiry and strike. Maturity date of the bond is determined by the option expiry date.

Upon confirmation of spot asset, put, and call price, interest bearing bond tokens will be issued to user. Each bond token will be redeemable at Sollar protocol upon maturity. By design, bond tokens of the same maturity date are fungible. Maturity dates are matched with the underlying position option expiry date. Ideally bond tokens should be traded on secondary markets such as Serum for market-based interest rate discovery.

Bonds have the following benefits:

1. **Fixed and guaranteed yields.** Users can depend on the cash flow from the bonds to make liquidity and risk management decisions.
2. **Liquidity**: because bonds of the same maturity are fungible, Sollar intends to back stop the liquidity of the bonds on a DEX such as Serum.

b. Fixed Rate Term Loans

A fixed rate term loan can be structured in almost a reverse manner of the bond:

$$-X * e^{-r*t} = C_S - P_S - S_0 + P_X + y \quad \text{(iii)}$$

Where:

$X * e^{-r*t}$	The present value of loan issued to user
X	The repayment value of the loan issued
P_S	Put option with S_0 as strike price and t as expiry
S_0	Underlying spot asset
C_S	Call option with S_0 as strike price and t as expiry
P_X	Put option with X as strike price and t as expiry
y	Residual cash

User deposits a collateral to Sollar. Sollar immediately sells the collateral asset for cash and enters into a three-legged option position in which:

1. Long call and short put at the strike closest to S_0
2. Long put at the strike X

All option positions have the same expiry, t, and size. The present value of the loan, $X * e^{-r*t}$, is lent to the user. Upon maturity of the loan, the user has the option to pay back X and in exchange for the collateral.

Users know the interest rate of the loan upfront - implied by the options market. Regardless of the spot price at maturity, the right hand side of (iii) will result in either: 1) X, or 2) S_t, whichever is greater in

value. Users will have incentive not to repay the loan at maturity if $S_t < S_0$. However, The right hand side of (iii) ensures that Sollar's lending position is guaranteed through the option positions. Note that the interest rate for the synthetic loan is not the same as the synthetic bond.

The structured loan above has the following benefits:

1. **No liquidation risk**. As one can see, the right hand side of the equation has no spot collateral. The options used are European options and therefore cannot be exercised prior to maturity.
2. **Fixed and known interest rate up front**. Users will know how much interest rate they will need to pay up when the loan is issued.
3. **No duration risk**. Because there is no liquidation risk, the duration of the loan is guaranteed.

We observe that (iii) resembles synthetic call options. We also observe that defi collateralized loans with fixed LTV also resemble a call option on the collateral with LTV as strike plus cash.

3. Protocol Risk Management & Liquidity

We have presented two financial instruments. It should be noted that they have certain offsetting features such as $P_0 \approx P_S$ and $C_0 \approx C_S$. While the loan and bond positions are risk free to Sollar, there are netting features that frees up liquidity of the protocol.

Bonds and loan issuance can be done through either epochs (pioneered by defi option vaults), or just in time (JIT) through on-chain order books. Please see section 5 on limitations and risks.

4. Considerations for Implementation

Although we shall not bore the reader with implementation details, we outline the following considerations when developing the protocol:

- Liquidity of on-chain option market is scant as of February 2022
- Ideal user experience: deposit a token, get a loan. Deposit stablecoins, get a bond
- Offer small amount of loan at first and then gradually increase loan amount and or LTV as option markets mature
- RFQ system providing concentrated liquidity may improve yield and user experience until on-chain order book provides enough depth and breadth (if)
- Look at where option market depth may become in 2023 and 2024 and design protocol accordingly.
- Note almost all trad-fi bonds are traded through OTC desks. Defi bonds have advantages of composability which may carry a different trading model than trad-fi bonds
- Prepayment of loan should be possible with penalty.
- Loan term should be short and not exceed 6 months

5. Roadmap

As mentioned earlier in this litepaper, interest rate is one of the foundational building blocks of finance. We believe decentralized finance is no exception. Here is an approximate roadmap and future implementation that the team foresees::

Q1 - Q2 2022:	Development of protocol. Establish ecosystem partners & composability
Q2 2022:	Implementation of Sollar on devnet for technical testing and user feedback
Q2-Q3 2022:	User onboarding. Solicitation of liquidity through Serum orderbook and or market makers. User education and increase bond & loan composability.
Q3-Q4 2022:	Initial mainnet-beta launch. Funding for hiring. Market making of bonds on Serum DEX Savings products
2023 +	Floating rate bonds & savings products Credit & Insurance products Swap products

6. Limitations and Risks

The market depth and liquidity of on-chain European options are unknown at the moment. At the same time, the demand for fixed-rate bonds in decentralized finance is unknown. There are regulatory uncertainty and risks with the decentralized finance ecosystem. Option market may not be liquid enough to support a robust fixed income market. Solana ecosystem is new and growing. Its robustness is still yet to be proven on a long term basis.

7. Conclusion

We proposed an on-chain and decentralized fixed income & interest rate protocol powered by options - Sollar. Sollar helps users better manage their defi liquidity and risk needs by offering fixed rate borrowing and lending products. We believe in decentralized finance and its promises. By bringing fixed yield to defi, we hope to further defi's ethos of equity and openness, broadening the appeal of defi for us all.