

Morpho

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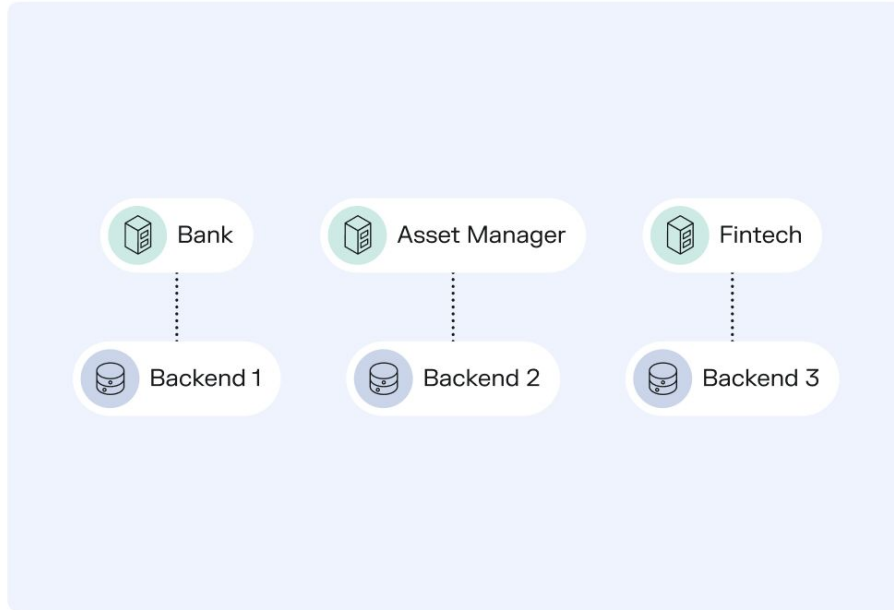
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What is Morpho

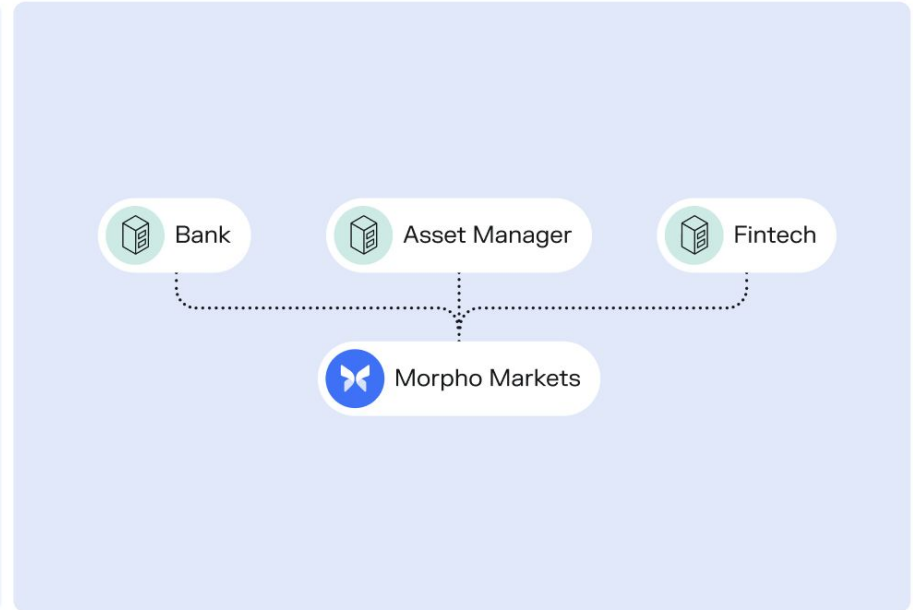
- Morpho was started in 2021. Now a team of about 60 people.
- Morpho is developing an infrastructure for lending and borrowing on the blockchain.
- This infrastructure can be used by actors to issue loans or to lend money.

What is Morpho

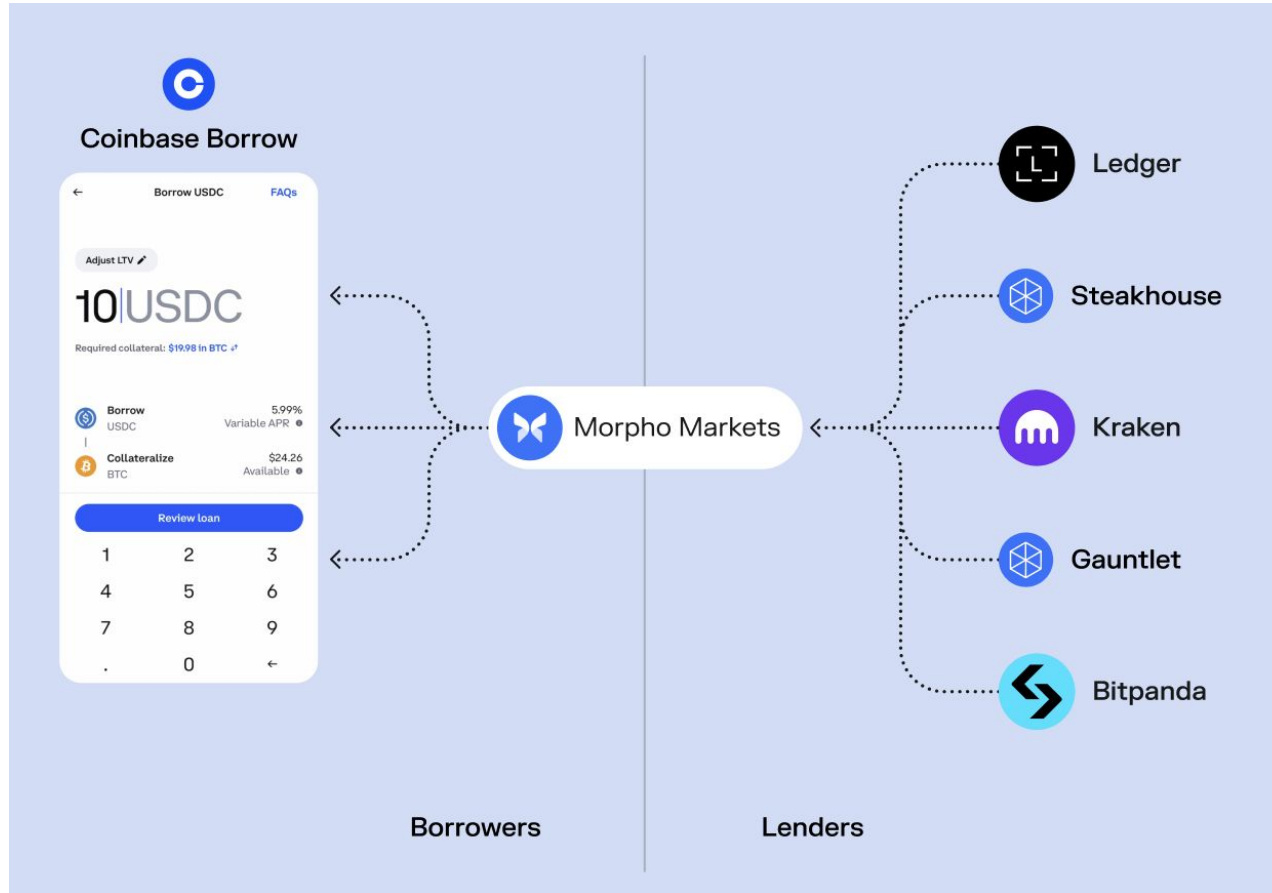
Before Morpho



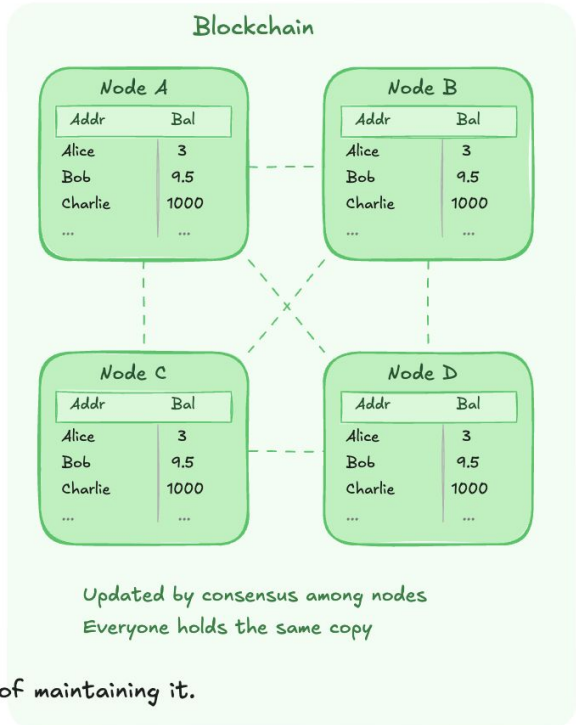
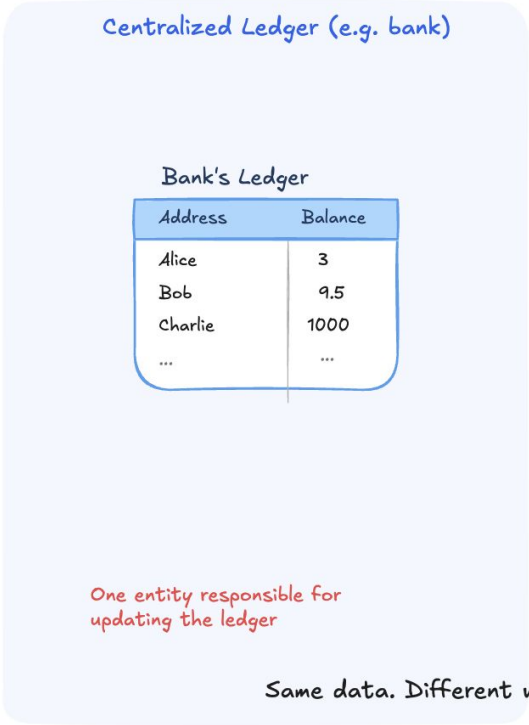
After Morpho



What is Morpho



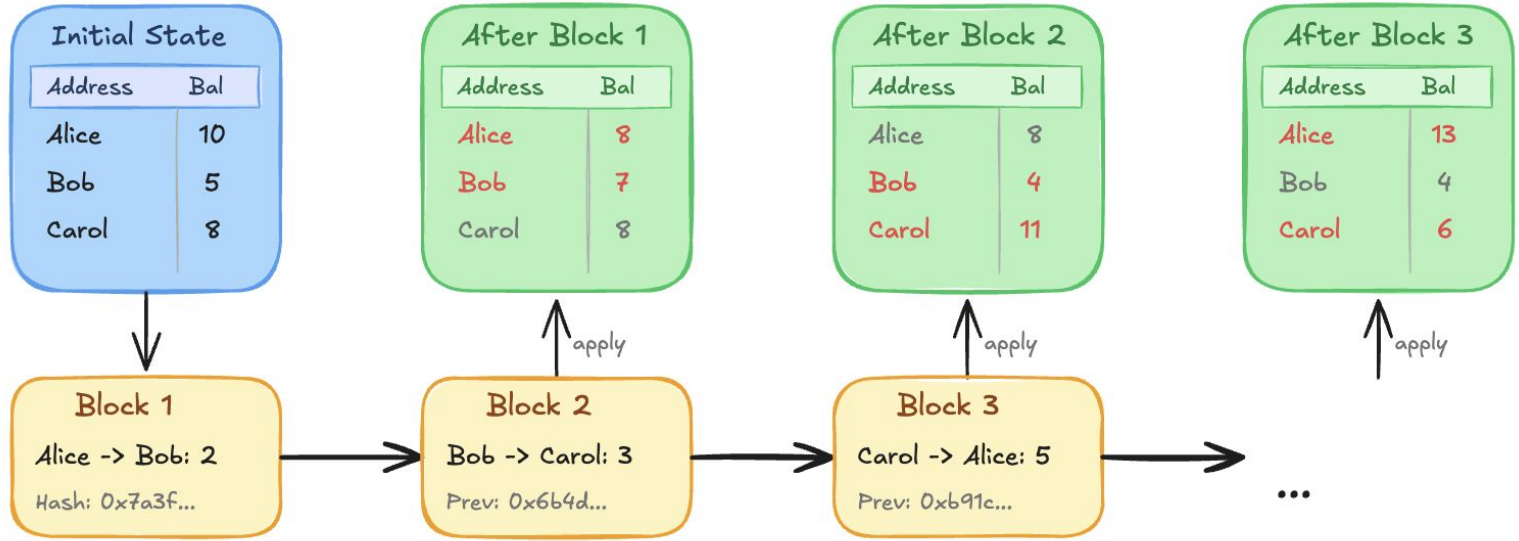
Blockchain basics



Same data. Different way of maintaining it.

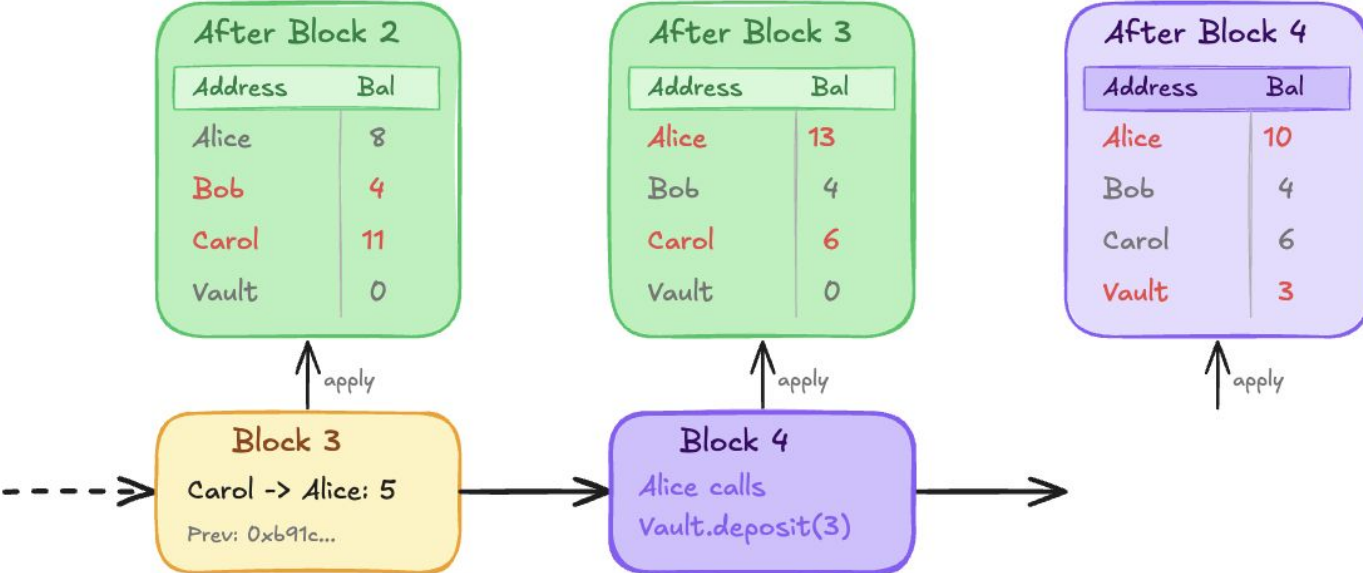
- A shared ledger that no single entity controls
- Shared ledger updated according to consensus rules (e.g. everyone agrees, BFT, Nakamoto)

Blockchain basics



- Ledger is updated through transactions.
- Transactions are grouped into blocks, chained cryptographically.
- Thousands of nodes worldwide each hold a full copy.
- Once written, data is practically immutable

Blockchain basics: Smart Contracts



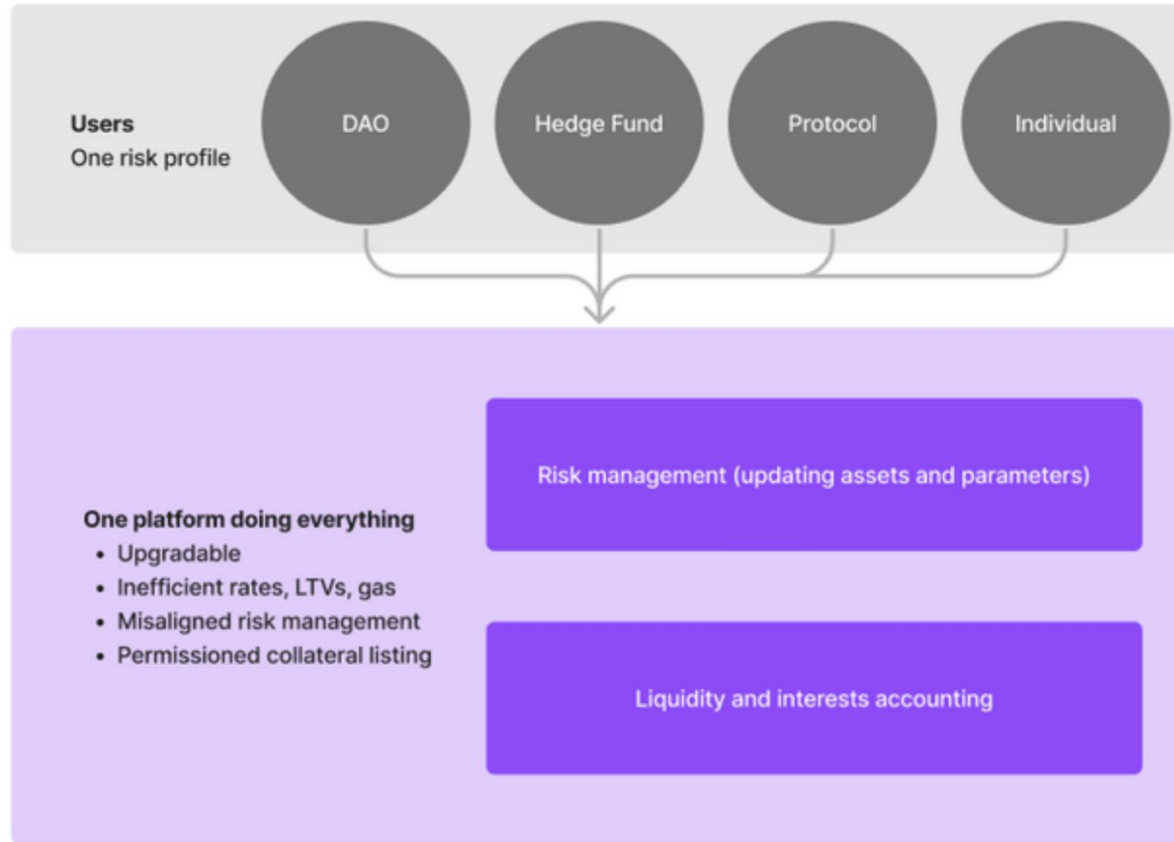
- The ledger can be also updated using Smart Contracts
- A smart contract is just another address in the ledger, controlled by code.

Blockchain basics: Smart Contracts



- Smart contract: code deployed on the blockchain
- Anyone can interact with (permissionless)
- It can hold and manage assets according to its programmed rules (trustless)
- Once deployed, the code cannot be changed (immutability)
- Anyone can read the code and verify what it does (transparency)

Onchain funds



Chaos Risk Oracles

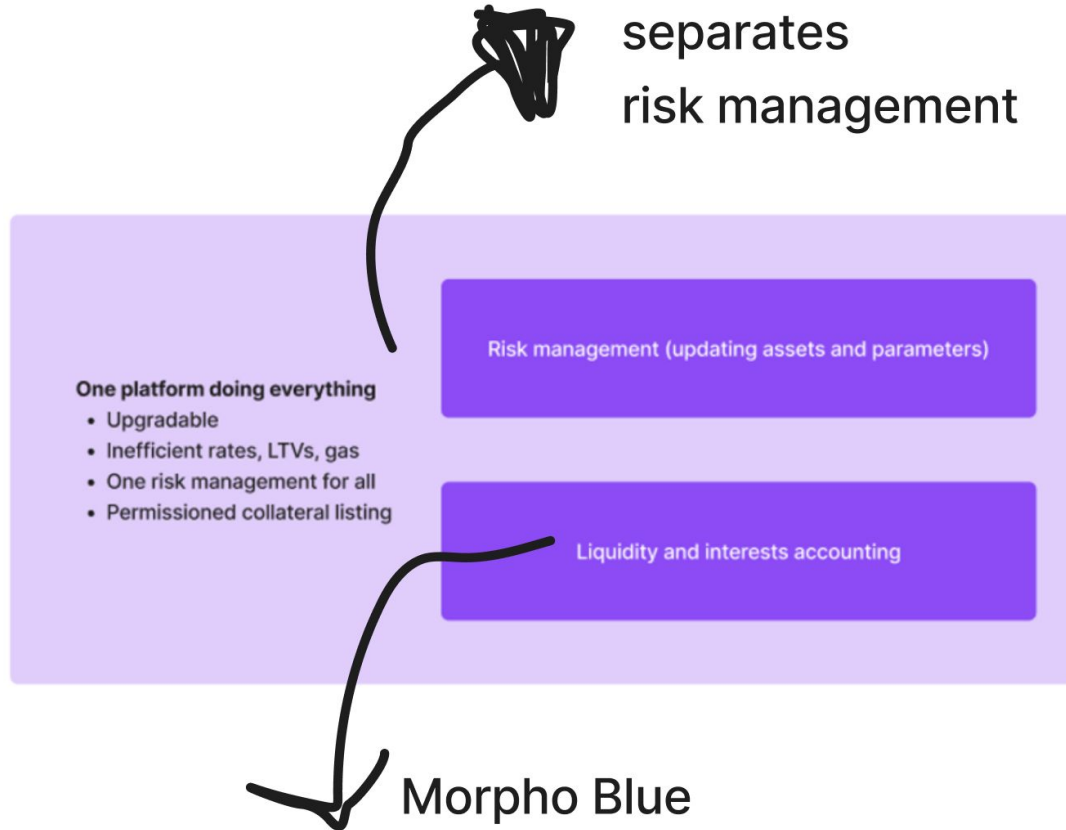
2,000+

Parameter Updates

Across multiple chains and hundreds
of markets



Morpho



Morpho Architecture: Markets



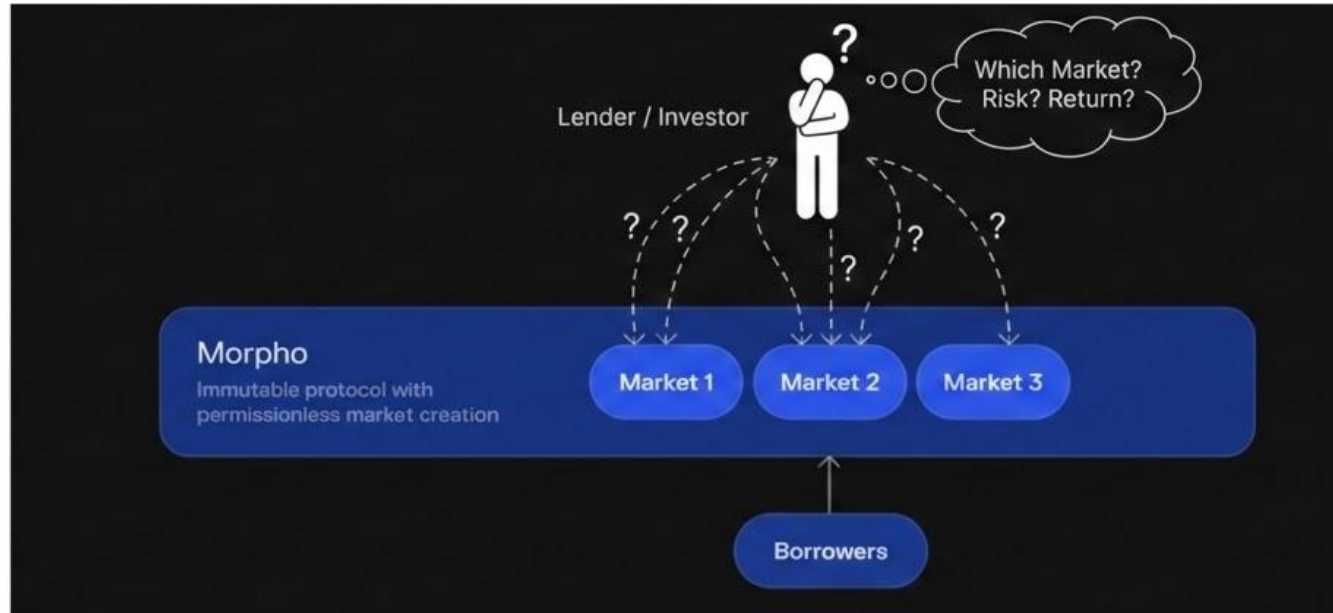
- Markets are primitive lending markets (e.g. different type of loans, different assets)
 - Example: USD loan backed by Bitcoin collateral.
- Market creating is permissionless: anyone can create markets.

Morpho Architecture: Markets



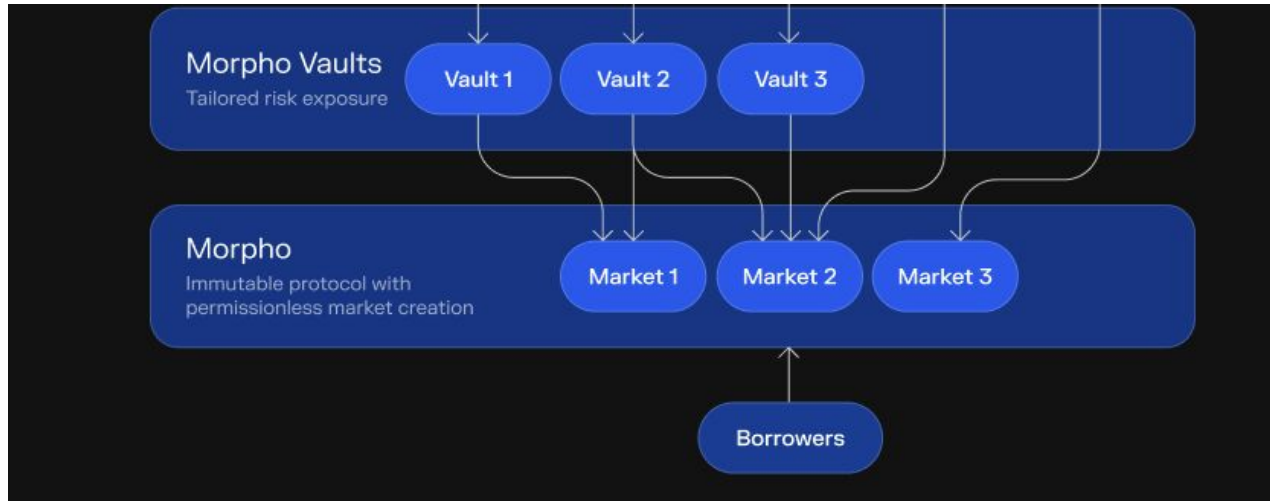
- Borrowers can tap directly in markets to borrow.
- Markets are shared: different lenders and borrowers interact with the same market as long as it's the same type of loans.

Morpho Architecture: Markets



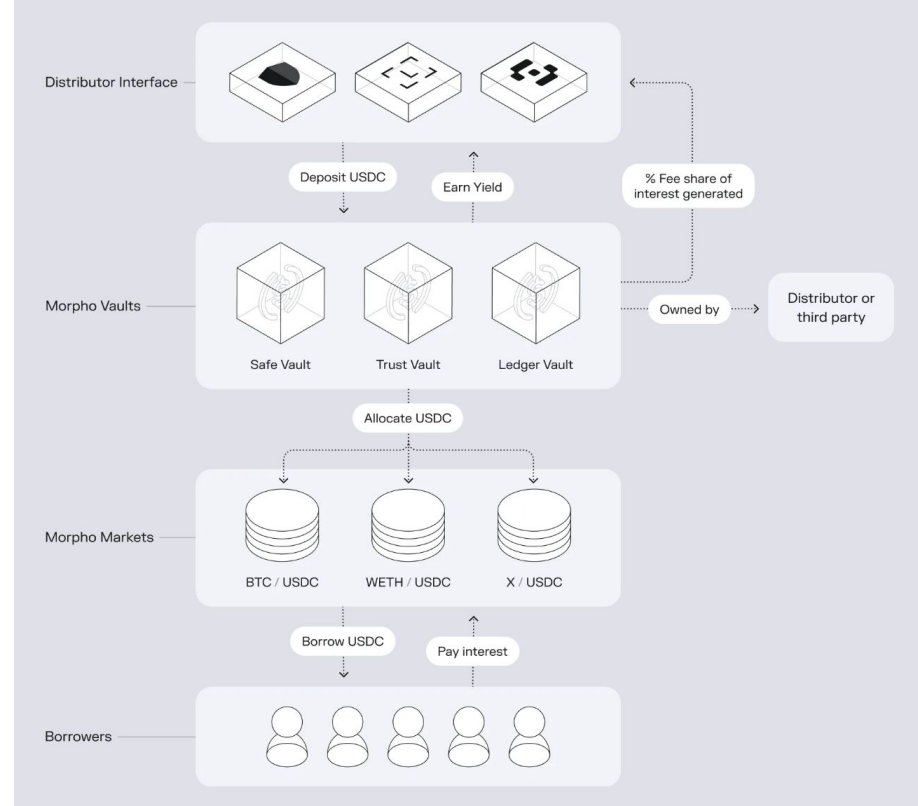
- Assessing the risk of different markets is difficult: it requires constant monitoring as risk change over time, it's operationally difficult...
- Some entities have expertise in assessing risk of different opportunities (banks, asset managers, ...).

Morpho Architecture: Vaults



- Vaults allow users to delegate management of their assets to external parties (curator)
- Curator allocate funds between different markets based on their risk assessment.
- There's no "one size fits all" risk profile. Some people want very secure products, some want to target higher yield. Depositors choose between vaults based on their risk appetite.
- Markets are shared between different vaults: competing vaults deposit into shared markets, no liquidity fragmentation, borrowers access a "global liquidity".

Morpho Architecture



- Fintechs can give users access to “earn products” using vaults under the hood (e.g. Société Générale, Coinbase, ...).
- They can own or chose a vault that is in line with their risk requirements.

Markets

- If you take a loan in the real life, you go to a bank and ask your banker for the terms (interest, duration, ...). If you don't repay, your assets get seized, you go to jail, ...
- What does it mean to create lending markets on a smart contract (remember that everything is set algorithmically!)?
 - How to ensure that people repay?
 - How to set interest rate?
 - Prices: how to accurately get prices for the assets?

Vaults

- If you have some assets in a bank account, the banker cannot use it freely (regulation, sanctions, ...)
- What does it mean to create vaults on a smart contract?
 - How to ensure that the curator cannot walk out with the user funds?
 - How to enforce a given risk policy?
- Morpho Vaults are **non-custodial**: users can always opt-out of the vault, regardless of curators actions.

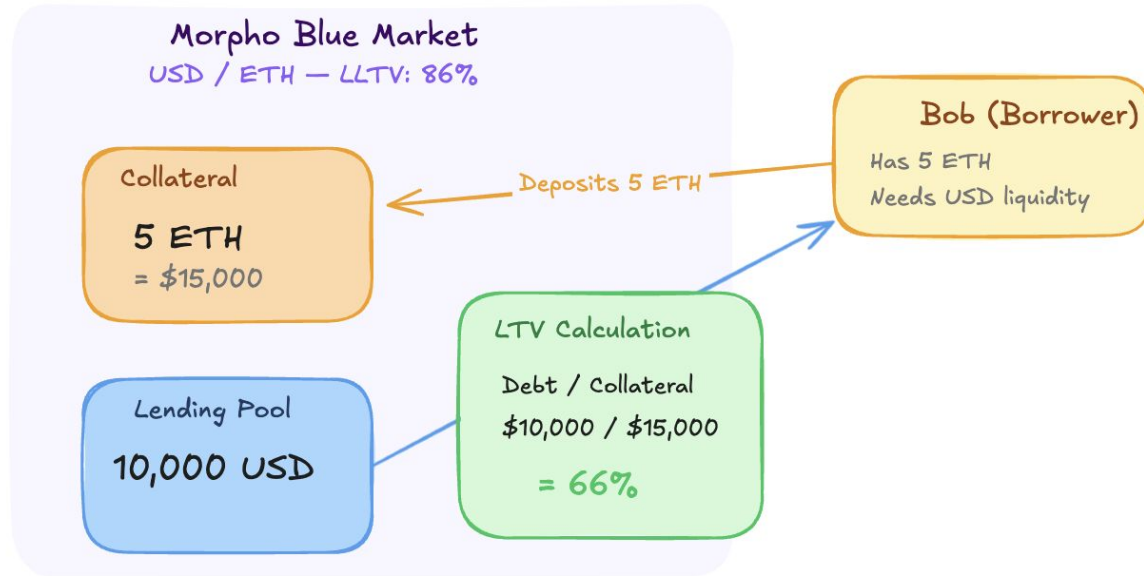
Markets: Loans

Lender	Amount Lent
Alice	10
Bob	15
...	...

- A loan is some sort of promise of repayment backed by some trust assumption [1].
- One simple trust assumption is collateral: you put \$150 worth of assets to borrow \$100.
- Morpho only does over collateralized loans (for now).
- Very similar to the repo market in essence.

[1] <https://morpho.org/blog/the-price-of-trust/>

Markets: Loans



- All loans are over collateralized (e.g. you put \$2000 worth of Ethereum and borrow \$1000 of USD).
- Borrowers can only borrow up to some loan to value (LTV = loan value / collateral value).
- Markets are defined by the loan asset, the collateral, the LTV (and the source price).

Markets: Loans

```
function borrow(
  MarketParams memory marketParams,
  uint256 assets,
  uint256 shares,
  address onBehalf,
  address receiver
) external returns (uint256, uint256) {
  Id id = marketParams.id();
  require(market[id].lastUpdate != 0, ErrorsLib.MARKET_NOT_CREATED);
  require(UtilsLib.exactlyOneZero(assets, shares), ErrorsLib.INCONSISTENT_INPUT);
  require(receiver != address(0), ErrorsLib.ZERO_ADDRESS);
  // No need to verify that onBehalf != address(0) thanks to the following authorization check.
  require(_isSenderAuthorized(onBehalf), ErrorsLib.UNAUTHORIZED);

  _accrueInterest(marketParams, id);

  if (assets > 0) shares = assets.toSharesUp(market[id].totalBorrowAssets, market[id].totalBorrowShares);
  else assets = shares.toAssetsDown(market[id].totalBorrowAssets, market[id].totalBorrowShares);

  position[id][onBehalf].borrowShares += shares.toUint128();
  market[id].totalBorrowShares += shares.toUint128();
  market[id].totalBorrowAssets += assets.toUint128();
  Accounting

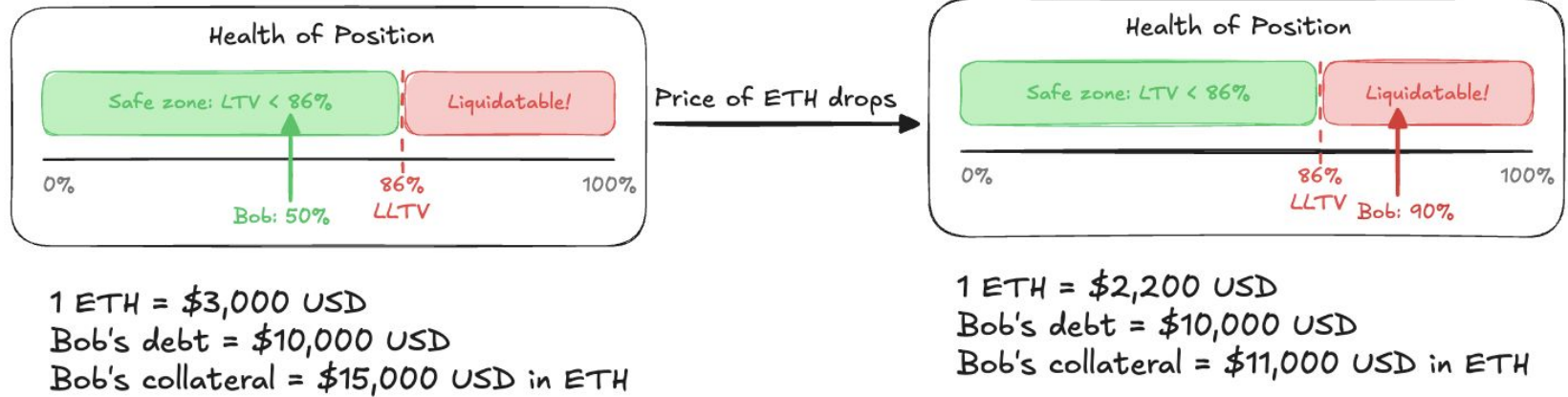
  require(_isHealthy(marketParams, id, onBehalf), ErrorsLib.INSUFFICIENT_COLLATERAL);
  require(market[id].totalBorrowAssets <= market[id].totalSupplyAssets, ErrorsLib.INSUFFICIENT_LIQUIDITY);
  Check LTV

  emit EventsLib.Borrow(id, msg.sender, onBehalf, receiver, assets, shares);

  IERC20(marketParams.loanToken).safeTransfer(receiver, assets);
  Transfer funds

  return (assets, shares);
}
```

Markets: Liquidations



- Price of collateral can change! If value of collateral fall below the loan value, lenders would lose.
- When the position is above the liquidation threshold (LLTV), anyone can seize the collateral by repaying the debt (and sell it): it's a function of the smart contract.

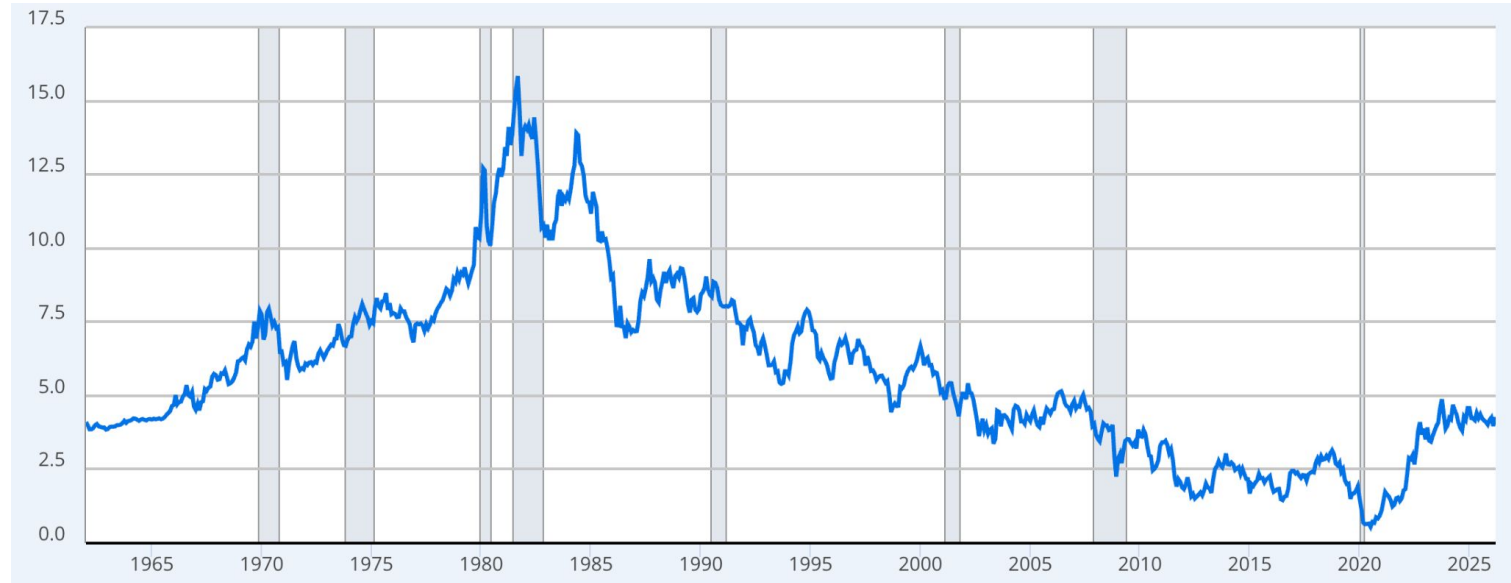
Markets: Liquidations



- Liquidators are incentivized to do so: they can take all collateral but only repay part of the loan.

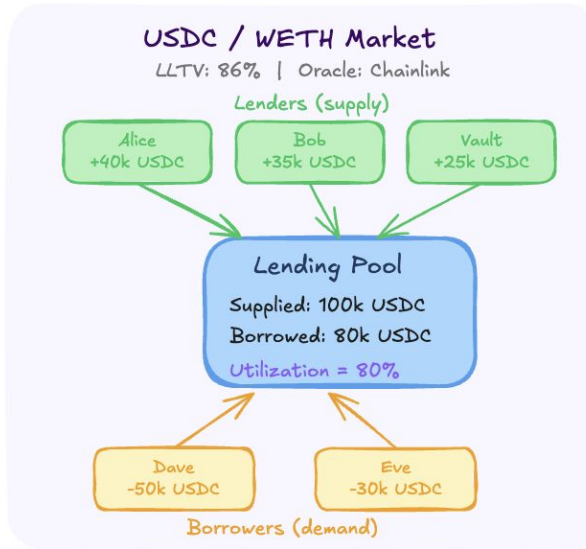
Actor	Before	After	Net result
Bob	5 WETH (\$11k) - 10,000 USDC debt	0 WETH 0 USDC debt	Lost ~\$1,000 (liquidation penalty)
Charlie	10,000 USDC 0 WETH	0 USDC 5 WETH (\$11,000)	Gained ~\$1,000 (liquidation incentive)
Lenders	10,000 USDC lent at risk if Bob defaults	10,000 USDC returned + interest earned	Protected (debt fully repaid)

Interest Rate

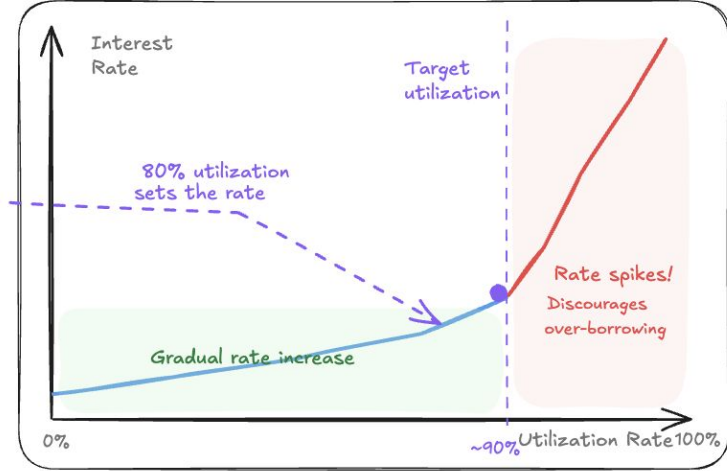


- Interest cannot be set once and for all. Interests vary a lot depending on macroeconomic.
- Could be a parameter that is set regularly but complex operationally, does not scale well to many different loans.

Interest Rate

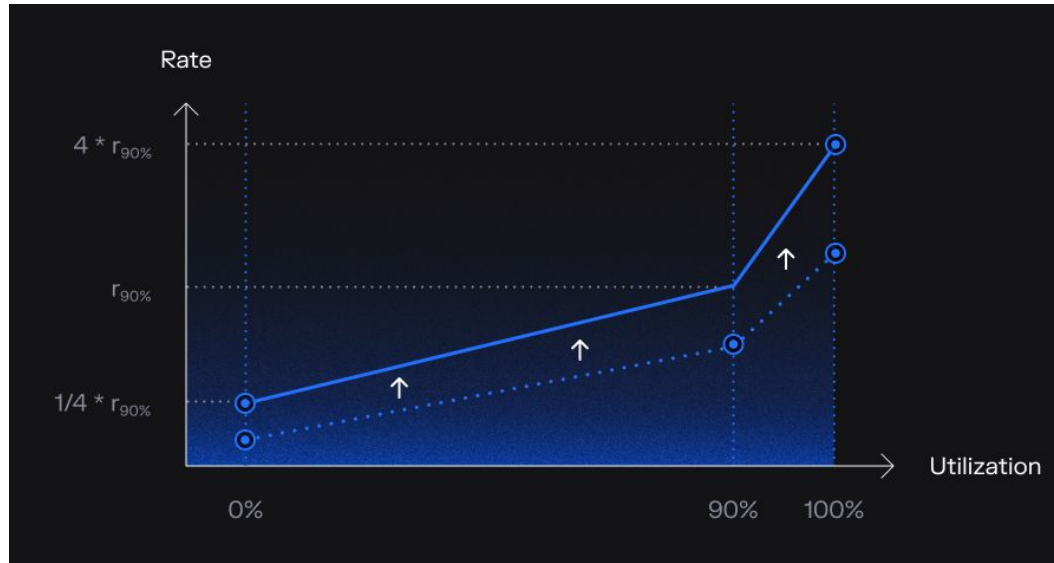


The Utilization Rate Model



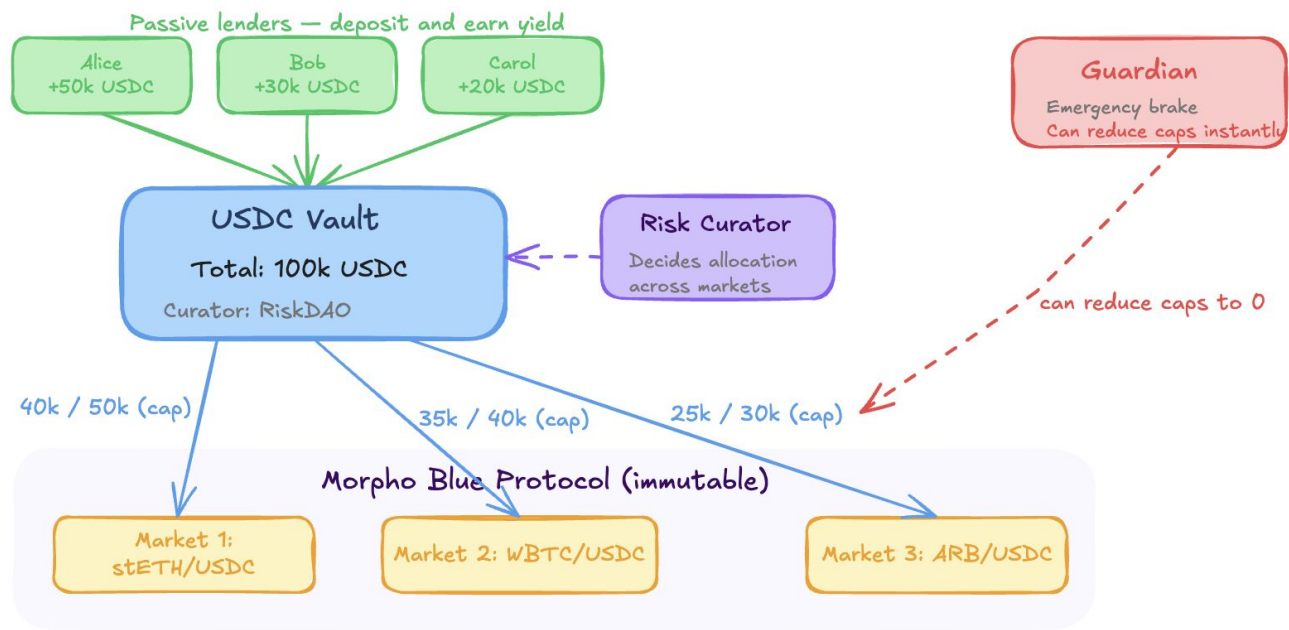
- Interest is variable and depend on utilisation.
- Rate increase slowly until target utilisation rate (90%), then very steeply.
- Self-balance: high-rates attract more lenders and push borrowers to repay. Utilization drops and rates decrease, and conversely for low rates

Interest Rate



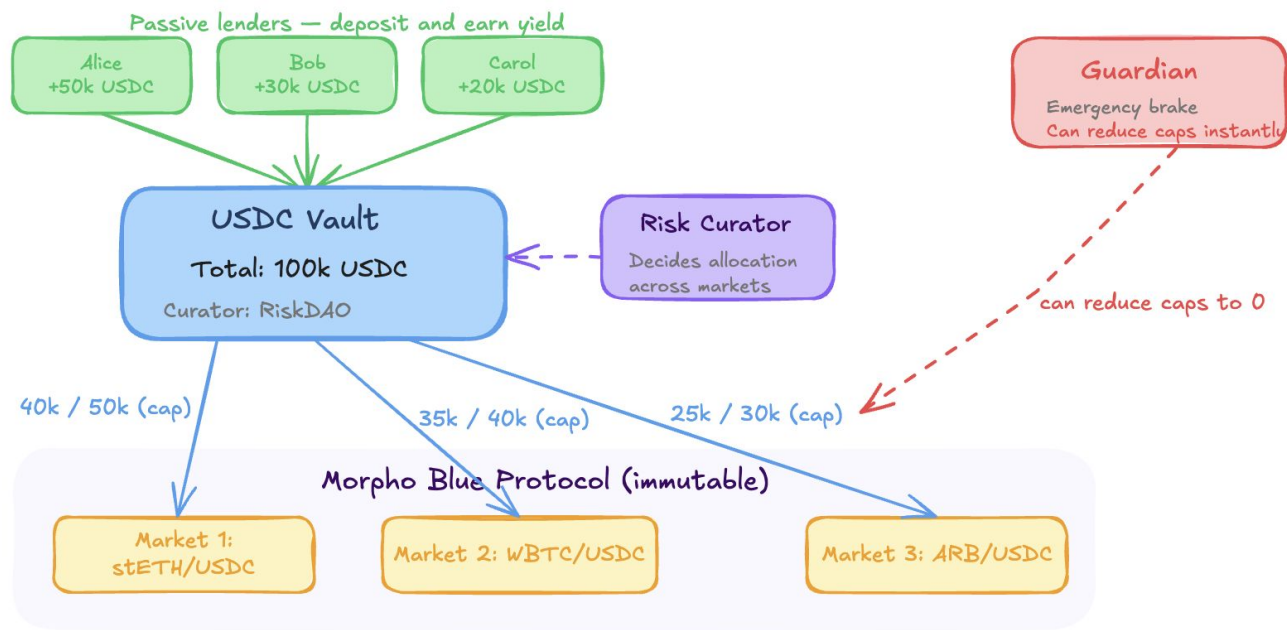
- It's not enough to have a static curve as the rate at target utilization is asset dependent (lenders want to get paid more for riskier collaterals or LTV).
- The curve is adaptive: if the current utilization stays above the target utilization, the rate at target utilisation will increase and inversely if utilization is below target utilization [1].

Vaults



- Morpho Vaults are **non-custodial**: users can always opt-out of the vault, regardless of curators actions.
- Achieved using a combination of different roles (owner, curator, allocator, guardian), with segregated responsibilities and timelocks for actions.

Vaults



- Curator: define the strategy (markets, caps for all markets).
- Allocator: allocate inside strategy defined by the curator.
- Guardian: can remove markets in case of emergency.
- Timelock: roles cannot take risky actions immediately, it takes a cooldown period.
- Example: A curator cannot allocate to a new market instantaneously, it takes time. If depositors do not agree with the curators action, they have opportunity to get out.

Limitations and perspectives

- Interest rates are determined by the IRM. Works but is not the most efficient design.
 - Rates can be volatile. Lead to unpredictable for borrowers.
 - Underutilization of capital (90% target rate).
 - Can't have fixed rate.
 - Can't use different collaterals. Or no collateral.
- Now developing a new fixed rate protocol that works as zero coupon bonds.
 - Market driven rates.

Limitations and perspectives

But we need another unlock to go beyond crypto-backed loans

~\$200T in global credit markets. Almost none of it is onchain yet.



Sources: Galaxy Research, IIF, IMF, OECD, SIFMA, OFR, ICMA, Prequin, DefiLlama (2024-26 est.)

Thank you!