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Blockchain data exploration by central banks: outcomes from an ECB Decentralised Finance (DeFi) hackathon

- a case study by the winning team -

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Outline

- Gentle introduction to Decentralised Finance (DeFi)
- ECB DeFi hackathon – an opportunity for speed learning and knowledge sharing
- How do DeFi lending/borrowing protocols work?
- What is the value proposition of DeFi payment protocols?
- What is the role of blockchain oracles in DeFi?
- Hackathon – challenges & outcomes
- What have we learnt about DeFi data?
- Concluding remarks

Gentle introduction to Decentralised Finance (DeFi)

Decentralised Finance (DeFi)

- seeks to emulate various financial products and services through smart contracts on programmable, typically permissionless blockchains
- enables peer-to-peer provision of financial products/services and aims to dispose of centralised intermediaries
- took off in 2020 with the introduction of smart contracts on the Ethereum blockchain, but is small
- remains unregulated, unsecure, untested, with intricate protocols, and posing significant risks to users

DeFi on-chain data

- are accessible to everyone, but remain pseudonymous, opaque and cumbersome to analyse, also due to the lack of standards and heterogeneous approaches across blockchains and protocols
- readily available public data on DeFi generally lack granularity and are prone to gaps



Hackathon as a means to develop methods for risk analysis and share knowledge among central banks as they also seek to capture DeFi in official statistics

ECB DeFi Hackathon – speed learning and knowledge sharing

- The word *hackathon* is a portmanteau of *hack* and *marathon*; *hack* is used in the sense of exploratory programming
- The ECB DeFi hackathon: a 48-hour remote competition aimed at participants from ESCB and SSM to solve a set of three challenges:
 1. Analysis of blockchain data for Aave, one of the biggest DeFi lending/borrowing protocols
 2. Analysis of blockchain data for Sablier, one of the DeFi payment protocols
 3. Exploring the risks of blockchain oracles
- Constrained by the hackathon timeline, participants did not strive for comprehensiveness but for demonstrating the potential for granular on-chain data analysis.



Photo source: Harvard Business Review

How do DeFi lending/borrowing protocols work?

- Borrowers interact with smart contracts that pool liquidity supplied by lenders (liquidity providers)
- The interest rate on borrowed amount is set automatically depending on market conditions or on parameters defined in the governance process of the protocol
- Lenders deposit crypto-assets and in return receive other crypto-assets that allow them to redeem deposits later in time, plus a reward or fee
- DeFi lending protocols require overcollateralization; if a loan position is insufficiently collateralised, the loan might be liquidated
- Borrowing can be uncollateralised as e.g. in flash loans which have become one of the most creative tools in the DeFi segment
- Flash loans are either executed and repaid within the same blockchain transaction or reverted

What is the value proposition of DeFi payment protocols?

- DeFi payment protocols enable instant peer-to-peer paying, sending and receiving crypto-assets, often across various blockchains also in regular intervals (*money streaming*)
- Money streaming concerns recurrent payments or payments occurring over a specific duration with a predefined rate e.g. salaries, subscriptions, donations, continuous auctions
- A payer deposits into a smart contract an amount of a crypto-asset; this amount is unlocked in agreed fractions (time-wise e.g. daily or other) to a payee
- While proposing innovative approaches to the current payments infrastructure these protocols remain niche even compared with other DeFi protocols

What is the role of blockchain oracles in DeFi?

- Blockchain oracles are third-party services that enable DeFi protocols to receive external data necessary for the execution of their smart contracts
 - E.g. lending/borrowing protocols use price feeds offered by oracles e.g. to fetch real time pricing data to calculate the valuation of each user's collateral and debt in order to determine when liquidations should be initiated
 - Hybrid crypto/fiat payment protocols may use oracle price feeds to determine exchange rates, allowing users to pay with a wide range of crypto-assets while the merchant still receives their preferred form of payment.
- Oracles can supply on-chain or off-chain information (e.g. prices of real-world assets, weather information, race results etc)
- The fact that DeFi protocols must rely on off-chain data to function, which leaves room for manipulation, is referred to as the Oracle dilemma/problem
- Manipulations/malfunxions may concern off-chain data manipulation, on-chain infrastructure bugs/errors, faulty data feeders, and control attacks

DeFi hackathon – challenges & outcomes



Challenge 1. Analytical questions/indicators to be covered in the analysis based on Aave data

What are the indicators on DeFi lending (e.g. number of users/new users, lending rates, lending amounts, repayment of loans, liquidation factor, liquidation amounts, collateral used, debt tokenisation, credit delegation and insight into deposit pools, etc.)?

How do indicators on DeFi lending compare across various blockchains?

What are the risk characteristics of the loans and potential mitigants (e.g. collateral)? Can metrics identify loans with different credit risk assessment/non-performing loans?

What information is available on borrowers?

Are KYC-enabled permissioned parts of the protocol included in the dataset?

Is there any information on flash loans? What indicators help to analyse the risks from flash loans?

Is any information on "mempool" available which could be used by sophisticated actors to force liquidations by creating artificial price volatility?

- Indicators such as number of addresses, borrowing rates, borrowing amounts, liquidity factors

- Indicators for Ethereum, Matic and Avalanche blockchains

- Indicators such as concentration of borrowers

- Indicators such as evolution flash loans in USDC, DAI and USDT, flash loan amounts

- Commentary on risk

DeFi hackathon - outcomes



Challenge 2. Analytical questions/indicators to be covered in the analysis based on Sablier data

What are the indicators on users of this protocol?

Can the purpose of transactions be distinguished?

Can geographical angle of transactions and users be grasped based on the data?

Can one infer crypto-assets payments attitudes from the data presented?

Are there any differences in transactions and users on various blockchains?

Can vendors be identified?

Is it possible to obtain information by type of sectors/services of the economy (e.g. e-commerce, travel and tourism, entertainment, Luxury & Fashion, etc)?

Are there any insights available based on the data on the major players?

Is money streaming widely used?

What are potential risks from DeFi payment protocols?

- Indicators such as number of addresses, “age” of addresses

- Proxies based on transaction times using an unsupervised ML model

- Indicators for Ethereum, Arbitrum, Avalanche, Binance Smart Chain, Polygon, and Optimism

- Indicators such as number of streams by duration, “sleeping” balances for selected stablecoins, concentration,

- Commentary on risk

DeFi hackathon - outcomes



Challenge 3. Analytical questions/indicators to be covered in the analysis of oracles

What are business models of blockchain oracles service providers?

How are oracles linked to DeFi protocols? How do they feed their data to the DeFi protocols?

What are the risks associated with oracles?

Examples of malfunctioning oracles. Were malfunctioning oracles another of DeFi's flaws exposed during the UST failure?

How reliable are the data from oracles? How oracle service providers quality-assure their data? Is it checked beforehand? Is there any independent/third party providing assurance?

What is the concentration of oracle service or oracle providers? Are there oracles that are superior in the sense of having larger underlying data to generate/display prices, in terms of governance, or in the sense of having better mechanisms to avoid malfunctioning or cyber-attacks?

What are the available data sources concerning oracles?

- Largely based on *Chainlink*, one of the well-known oracle providers

- Case studies of oracle manipulations (Hardcoded LUNA price, the Synthetix sKRW incident, Chainlink node attack via gas fee)

- Commentary on Total Value Secured (TVS)

- Policy reflections (secure coding practices, robust risk management practices, audit and independent review)

What have we learnt about DeFi on-chain data?

- Aave on-chain data were made available to the hackathon participants in 130 tables, however, comprehensive information about the specifications of each table were difficult to find, reflecting a typical challenge anybody looking at these data faces
 - E.g. all amount information is stored as integers rather than decimal numbers and each crypto-asset has its own decimal system (one Tether is divisible to 18 decimal places, Bitcoin – to 8 decimal places)
- Harmonising units e.g. expressing values in USD was quite challenging as auxiliary information was spread across various tables
- Standardising units e.g. of borrowing rates required making assumptions
- Disentangling the information on the underlying asset address from the liquidity pool address and sometimes the user address/transaction hash was difficult
- Sablier data were provided in 30 tables and were relatively straightforward, still some assumptions had to be made when linking information from various tables

Concluding remarks

- While the DeFi sector is not as large as traditional finance, it is still important to monitor and analyse the emerging trends and innovations within it
- The DeFi hackathon was successful in offering hands-on exposure to selected DeFi phenomena, related on-chain data, and developing expertise in central banks
- While the 48-hour event delivered various indicators and insights, further deepening of the analysis extending beyond the analysed protocols for lending/borrowing and payment, as well oracles is needed
- Blockchain data remain opaque and cumbersome to be processed and analysed
- Building up skills in crypto-assets and DeFi monitoring based on on-chain data is relevant for central bankers in the context of regulatory initiatives such as Markets in Crypto-Asset Regulation (MiCAR) but also statistical ones