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Mitigating risks in decentralized finance: A Systematic review of challenges and solutions

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***Abstract*---**The present research investigation thoroughly investigates decentralized finance (DeFi), addressing its core ideas, and different protocols, in addition to its implications within the financial system**.** The study aims to explicate the functionality and interoperability of various DeFi applications, including decentralized lending, automated market makers, yield farming, and stablecoin mechanisms. The methods included a literature review along with a synthesis of existing research and empirical data from prominent DeFi platforms such as Synthetix, MakerDAO, Uniswap, Aave, and Yearn Finance. The findings highlighted the decentralized characteristics and innovative abilities of DeFi protocols toward supplying financial services without traditional intermediaries. Significant conclusions encompass Synthetix's collateralization procedures, MakerDAO's DAI stability features, Uniswap's automated liquidity provision, Aave's lending and borrowing dynamics, as well as Yearn Finance's yield optimization strategies. The analysis, additionally, emphasized the volatility and resilience factors affecting Total Value Locked (TVL) in the DeFi sector, influenced by cryptocurrency market fluctuations and operational risks. In summary, this research advances the understanding of DeFi's evolution, problems, and detrimental potential for transforming global the financial sector.

***Keywords*---**Traditional Finance (TradFi), Decentralized Finance (DeFi), Total Value Locked (TVL), Blockchain, Financial Technology (FinTech).

Introduction

Research Background

The emergence of blockchain technology marked the beginning of a new era of financial inventiveness, resulting in what is called decentralized Finance (DeFi).

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DeFi employs blockchain's decentralized, transparent, and unaltered characteristics to replicate traditional financial services and institutions, regardless of intermediaries. DeFi has expanded rapidly in recent years, revolutionizing how consumers and institutions interact with financial services such as lending, borrowing, trading, and investing.

Research Problem

Notwithstanding the immense acceptance and growth potential of DeFi, certain challenges remained. These consist of deficiencies in security, uncertainty regarding regulations, and sustainability concerns. Additionally, the ability to communicate various DeFi protocols, as well as their incorporation into the wider financial framework, garnered attention. This study aims to fill these gaps by conducting a thorough investigation of DeFi protocols, their applications, and their effects on the financial landscape. Accordingly, what are the challenges and possibilities for risk mitigation in decentralized finance?

Research Importance

Understanding DeFi is critical for all those involved in the financial ecosystem, including investors, regulators, and entrepreneurs. The research presented here delves into the functioning of DeFi protocols, highlighting their merits and limits, and investigating their ability to disrupt traditional finance. Such awareness is required for making informed decisions and promoting a more inclusive and efficient financial system.

Aims and Objectives

The primary objective of this study is to investigate the theoretical foundations, applications, benefits, and consequences of DeFi. The aims include:

1. To demonstrate the fundamental principles and mechanisms underlying DeFi protocols.
2. To evaluate the interoperability and real-world applications of key DeFi protocols.
3. To assess the benefits and challenges associated with DeFi adoption.
4. To explore the prospects and potential impacts of DeFi on the traditional financial system.

Research Questions

1. What are the core principles and mechanisms driving DeFi protocols?
2. How do different DeFi protocols interoperate, and what are their real-world applications?
3. What are the main benefits and challenges of DeFi adoption?
4. How might DeFi impact the traditional financial system in the future?

Research Rationale

The rationale for this research lies in the transformative potential of DeFi. As an alternative to centralized financial systems, DeFi offers the promise of increased

financial inclusion, transparency, and efficiency. However, to fully realize this potential, a comprehensive understanding of its mechanisms, challenges, and impacts is essential. This research seeks to contribute to that understanding, thereby aiding the growth and maturation of the DeFi ecosystem.

Key Findings

This research demonstrates that DeFi protocols like Synthetix, Maker DAI, Uniswap, Aave, and Yearn Finance offer groundbreaking financial services that challenge traditional financial paradigms. These protocols provide decentralized options for lending, borrowing, trading, and yield farming, each with unique features and advantages. However, challenges such as high collateral requirements, regulatory obstacles, and security risks remain. The analysis also underscores a significant correlation between DeFi's Total Value Locked (TVL) and cryptocurrency prices, highlighting the volatility and interconnectedness of the DeFi market.

Research Structure

The research is structured as follows:
Part 1: The introduction provides the research background, problem statement, research significance, aims, objectives, research questions, rationale of the research, and key findings.
Part 2: Theoretical Background of DeFi, it explores the evolution, characteristics, benefits, and limitations of decentralized finance (DeFi) within the blockchain ecosystem. It examines its transformative potential in financial inclusion, transparency, and security while highlighting challenges in governance, privacy, and regulatory compliance.
Part 3: Practical Background of DeFi, it examines diverse models of decentralized finance (DeFi) applications within the livestock sector, demonstrating transitions from fully disintermediated smart contract models to ordinary intermediated finance models. It explores their implications for data transparency, financial interactions, and regulatory challenges. Highlighting their potential to reshape traditional financial systems through blockchain technology.
Part 4: Conclusion summarizes the findings, discusses their implications, and provides recommendations for future research and practice.
Part 5: References.

2- Theoretical Background of Defi

This section explores the evolution, characteristics, benefits, and limitations of decentralized finance (DeFi) within the blockchain ecosystem. It examines DeFi's transformative potential in promoting financial inclusion, transparency, and security, while also highlighting the challenges related to governance, privacy, and regulatory compliance.

2-1 The Origin of DeFi
2-1-1 Key moments in the evolution of DeFi

Vitalik Buterin's Ethereum White Paper, which examined and anticipated the next generation of smart contracts, including decentralized autonomous organizations (DAOs), is credited with establishing the concept of decentralized finance (DeFi) in 2014. However, DeFi has its roots in earlier Bitcoin blockchain technologies, first presented in 2008 by Satoshi Nakamoto in a seminal white paper. This landmark document introduced peer-to-peer (p2p) transactions, revealing the potential for using blockchain technology to disintermediate financial services.

In this regard, blockchain is defined as: "(...) a type of distributed ledger, consists of unchangeable, digitally recorded data in packages called blocks. These digitally recorded 'blocks' of data are stored in a linear chain. Each block in the chain contains data (e.g., a Bitcoin transaction) and is cryptographically hashed. The blocks of hashed data put into play the previous block in the chain, ensuring all data in the overall 'blockchain' has not been tampered with and remains unchanged." This definition highlights five core elements of blockchain technology: (1) distributed database; (2) p2p transactions; (3) transparency with pseudonymity, (4) immutability of records, and (5) computational logic, which can trigger automated transactions via smart contracts.

A critical component in the context of DeFi is the smart contract, defined as "a computerized transaction protocol that executes the terms of a contract. The general objectives of smart contract design are to satisfy common contractual conditions (such as payment terms, liens, confidentiality, and even enforcement), minimize both malicious and accidental exceptions, and reduce the need for trusted intermediaries. Related economic goals include lowering fraud losses, arbitration and enforcement costs, and other transaction costs."

DeFi has been essential to Ethereum's growth since the platform's inception in 2015, especially until 2020, a period often referred to as the "DeFi summer." In 2020, DeFi began progressing from single-chain Ethereum applications to cross-chain applications, addressing early DeFi limitations such as scalability, security, centralization, liquidity, and information accessibility. Notwithstanding, the significant growth and proliferation of DeFi applications since then, the definitions of DeFi remain somewhat ambiguous. (Puschmann & Huang-Sui, 2024, pp. 1-12)

2-1-2 Definition of DeFi

Decentralized Finance (DeFi) refers to an innovative approach to financial technology (FinTech) centered around the use of blockchain technology. It facilitates financial services via freely available protocols and decentralized apps (DApps), reducing the need for conventional intermediaries comparable to banks, payment service providers, and investment funds. In its most fundamental form, DeFi provides a peer-to-peer (P2P) environment that enables direct interaction between fund providers and seekers. The fundamental objective of DeFi design is disintermediation. DeFi applications, on the contrary, may employ technical designs and constructs, such as smart contracts and tokens on peer-to-peer

networks, to deal with the informational challenges associated with intermediated finance without completely accepting a P2P model. These informational challenges originate principally from disparities in knowledge and asynchrony, which are prevalent in traditional intermediated financial services inside supply chains (Miller, Cao, Foth, Boyen, & Powell, 2023, pp. 1-13).

2-2 Characteristics and Origin of DeFi

2-2-1 Characteristics: A review of the existing literature displays three defining characteristics of DeFi: (Puschmann & Huang-Sui, 2024, pp. 1-12)

- Disintermediation: DeFi aims to eliminate or reduce the role of one or more intermediaries in financial transactions.
- Open and Decentralized Applications: DeFi encompasses new types of open, decentralized financial applications (dApps) that are dispensed on publicly accessible, permissionless blockchains.
- Smart Contract-Based: DeFi relies on an open, permissionless, publicly accessible, composable, and interoperable protocol stack built on smart contract platforms.

Table 1 presents an in-depth examination of traditional finance (TradFi) and Decentralized Finance (DeFi), illustrating the differences between the two financial systems. The comparison addresses numerous essential issues, illustrating the manner in which DeFi outperforms TradFi in terms of centrality, transaction costs, transparency, security, regulation, asset control, and accessibility. (Alamsyah & Farid Muhammad, 2024, pp. 1-12)

Table 1. TradFi vs. DeFi Comparison

Aspect	TradFi	DeFi
Centrality	They are centralized, they are managed by an institution or financial organization.	They are decentralized, they are governed and regulated by users or developer communities.
Transaction fees	They employ higher transaction fees due to the involvement of third-party intermediaries.	They employ lower transaction fees as they do not involve intermediaries.
Transparency	Transactions are not publicly accessible.	Open access to transaction flows, market prices, and asset ownership
Security	Centralized systems are often vulnerable to attacks, which can lead to widespread disruption across the entire network.	Utilizes blockchain and smart contracts to enhance decentralized security, thereby reducing vulnerability to hacking and cyberattacks.
Regulation	The financial regulator enforces regulations and rules.	No regulators, more freedom, and flexibility in innovation
Asset control	Managed by companies or financial institutions, such as banks or stockbrokers.	Users have complete control over their crypto assets.
Accessibility	Restricted to individuals who have access to traditional financial infrastructure, including banks, stock markets, and other financial institutions.	Accessible to anyone with internet access and a crypto wallet, offering global access to financial products and services without geographical or financial limitations.

Source: (Alamsyah & Farid Muhammad, 2024, pp. 1-12).

2-2-2 Roots

The foundation of DeFi is rooted in four expanding technologies that are commonly summed up by the acronym "ABCD": artificial intelligence (AI), blockchain, cloud, and data. Another variation of this acronym is AI, big data, cloud, and distributed ledger technology (DLT). In both variants, blockchain, and DLT comprise distributed ledgers and smart contracts, which are computer programs that automatically maintain, regulate, and maintain records of transactions and occurrences as they develop.

To comprehend the origins of DeFi, it is essential to explore this acronym. The following subsection provides a brief introduction to AI, blockchain, cloud computing, and data.

- Artificial Intelligence (AI):

The primary objective of artificial intelligence is to resemble human intelligence in terms of learning and problem-solving. It is required by this to use mathematical foundations as well as previous knowledge when drawing deductions and conclusions from data. Machine learning, which is a branch of AI, uses data, algorithms, and statistical techniques to improve computer performance when performing particular tasks.

- Blockchain, Distributed Ledger Technology (DLT), and Smart Contracts:

Smart contracts, distributed ledgers, and blockchains have all developed intricate links. A distributed ledger represents a database that stores user information as well as transactions and is dispersed over several different geographic sites. Centralized control and the necessity for intermediaries are eliminated by distributed ledgers. They are frequently combined with blockchain technology, which prevents cyberattacks by storing data in blocks connected to previously encrypted blocks. One popular blockchain platform is Ethereum. DeFi depends on users agreeing to terms and conditions through smart contracts, which facilitate the execution of transactions between anonymous parties without external enforcement. These transactions, secured by the blockchain, are stored in a distributed ledger.

- Cloud:

Since DeFi uses distributed services, data is not kept on centralized servers. Rather, data is stored on multiple cloud servers via cloud services. Because these services are metered and on-demand, customers can pay for the services they consume and request them as needed. Multiple customers can enjoy the services offered by the cloud service provider thanks to its multi-tenancy capability and wide network connectivity.

- Data or Big Data:

All operations require data, which includes both conventional data and "Big Data." Big and complicated sets of data that are beyond the scope of conventional data processing applications are gathered and processed as part of big data. It is comprised of vast amounts of data that have been collected from multiple sources and is distinguished by its volume, variety, and velocity—the three "Vs" of big data. (Kaur, Lashkari, Sharafaldin, & Lashkari, 2023, pp. 9-10)

2-3 Benefits and Limits of DeFi

2-3-1 Benefits and Potential

The decrease in transaction costs and inefficiencies related to trading, settling, generating, and transferring financial assets is one of the main benefits that DeFi can offer. DeFi can reduce the cost of loans for customers by doing away with middlemen like traditional banks, as they are not required to pay bank transaction costs. This cost savings is attained by optimizing multi-party coordination, streamlining contracting procedures, and utilizing cutting-edge technology to accelerate transaction speed.

In the following years, this possibility for cost reduction and increased efficiency is expected to profoundly impact various functions within the current securities as well as payments market infrastructure. This comprises real-time gross settlement systems (RTGS), custody services, foreign exchange (FX) services, repositories, and secure messaging systems. DeFi's ability to minimize friction and enhance transaction processes positions it as a transformative force in the financial sector. (Friesendorf & Blütener, 2023, p. 98)
Here are the main benefits of DeFi: (Moro-Visconti & Cesaretti, 2023, p. 307)

- Financial Inclusion: DeFi aims to offer economically disadvantaged or underprivileged individuals access to financial services by removing conventional barriers to loans, savings accounts, and investment opportunities.
- Transparency: DeFi transactions are recorded on public blockchains, guaranteeing transparent and auditable records of financial activities.
- Security: DeFi applications use blockchain's security features, such as cryptographic encryption and decentralized consensus, to protect user assets and data.
- Programmability: Smart contracts enable the automation of financial processes, eliminating the need for intermediaries and reducing human error.
- Innovation and Experimentation: DeFi creates an environment for developers to experiment with new financial products and services, fostering innovative solutions and novel use cases.

2-3-2 Limits

However, several basic constraints could pose substantial obstacles to the potential of decentralized finance (DeFi) based on blockchain technology. These constraints are typically associated with the intrinsic features of decentralized platforms and distributed trust.

- Cost of Distributed Trust: It might be costly to establish distributed credibility on decentralized platforms. Distributing information to all stakeholders in a public manner, obtaining consensus through distributed consensus, and storing redundant data among peers are the steps involved in achieving distributed trust via blockchain technology. The use of distributed trust may be limited by this process, which has the potential to significantly raise the costs of information preparation, processing, and storage.

- Privacy vs. Transparency: information is essential to distributed trust and decentralized networks, but too much information can jeopardize privacy. Transaction records are frequently kept and shown on public blockchains, however, they can be abused to jeopardize user privacy. Certain public blockchains, like Monero and Zcash, use sophisticated cryptography to hide user identities and transaction data while keeping public records to protect user privacy. However, because of the greater computational overhead associated with this strategy, transparency is decreased and information processing costs are raised.
- Rigidity and Inflexibility: Although public ledgers and smart contracts' immutability increases confidence and transparency, they also cause rigidity and inflexibility. DeFi, based upon blockchain technology and smart contracts, frequently obtains this inflexibility, potentially impeding experimentation, learning, and discovery. While smart contracts and decentralized platforms can be upgraded through distributed consensus, it is difficult to get general approval from stakeholders for significant upgrades. Without an agreement, operations might fail to proceed forward.
- Lack of Accountability: Given that central entities are not as involved with DeFi, there may be a lack of accountability, making it difficult to determine who is in charge of any wrongdoings that may occur in a decentralized financial ecosystem. There is no central authority to resolve disputes, stop transactions, solve concerns, or resume regular business in disputed circumstances. Inadequate responsibility may place major restrictions on DeFi.
- Limitations on Input Types: Distributed credibility may be achieved more successfully by decentralized platforms when inputs can be objectively documented and validated. However, many facets of daily life and business cannot be publicly disclosed or objectively codified on blockchains. As a result, the efficiency and potential use of a decentralized system of distributed trust may be limited since it may not make use of all accessible information.
- Rule of Code vs. Human Judgment: Instead of using human judgment, DeFi operations primarily rely on the rule of code. This reliance can lower subjectivity, uncertainty, and agency costs, but it can also impede DeFi's growth by not taking advantage of human judgment and tacit knowledge.

If not appropriately considered, these limitations may restrict the potential value and efficacy of blockchain-based decentralized finance. (Chen & Bellavitis, 2020, pp. 1-11)

2-4 Literature review

The body of research on decentralized finance (DeFi) has expanded significantly, reflecting the rapid development and acceptance of blockchain technology in the financial sector. A thorough examination from 2017 to 2024 indicates a wide spectrum of research endeavors targeted at understanding the disruptive potential and problems connected with these developing financial instruments.
Scholars have intensively researched the fundamental conceptual and technological foundations of DeFi, emphasizing its potential to transform traditional banking and finance by enabling peer-to-peer transactions and

eliminating middleman organizations. Majumdar and Gochhait (2022) underline the decentralization and transparency of DeFi, which offer considerable advantages, however, it demonstrates significant risks as well as concerns, such as security vulnerabilities and regulatory discrepancies. Jeong et al. (2023) provide insights into liquidity provision in decentralized exchanges, proposing innovative approaches to enhance market efficiency and mitigate liquidity risks. In the meantime, governance frameworks and security flaws in DeFi platforms were clarified by Angeris et al. (2023) and Dotan et al. (2023), highlighting the necessity of strong governance procedures and risk management techniques to protect user finances and guarantee platform integrity.

Furthermore, Trozze et al. (2024) and Vakhmyanin and Volkovich (2023) inquire into the intricacies of token smart contract code and derivative trading in DeFi ecosystems, providing insightful viewpoints on identifying securities violations and maximizing arbitrage opportunities. Simultaneously, research on NFTs examines the disruptive potential of these distinct digital assets in a range of fields, such as intellectual property, gaming, and the arts. Researchers have investigated the technical underpinnings of NFTs, their market dynamics, in addition to their implications for ownership rights and intellectual property protection. Sakas et al.'s (2023) research is significant for its innovative application of cryptocurrency market data for forecasting and modeling fertilizer industry stock values, highlighting the potential of NFTs and blockchain technology to revolutionize conventional financial markets.Nevertheless, despite the increasing interest in DeFi and NFTs, there are still significant gaps and contradictions in the research. Some studies warn against the inherent risks and weaknesses of these technologies, while others emphasize their revolutionary potential and advantages. Furthermore, the regulatory environment pertaining to NFTs and DeFi is still fragmented and changing, which presents difficulties for both policymakers and market players. To fill in these knowledge gaps, expand on our comprehension of the ramifications of decentralized finance and non-fungible tokens, and guide the creation of risk management procedures and regulatory frameworks in the digital asset market, additional research is required.

3- Applied Background of DeFi

The models of decentralized finance (DeFi) applications in the cattle industry are examined in this section, which includes both completely disintermediated smart contract models and typical intermediated finance models. It examines their effects on financial transactions, data transparency, and regulatory issues while emphasizing how blockchain technology can transform established financial systems.

3-1 DeFi Applications

DeFi technology has been employed in many different contexts, which has sparked the creation of multiple sub-technologies. The following lists several noteworthy and extensively used DeFi applications: (Banaeian Far, Imani Rad, & Rajabzadeh Asaar, 2023, pp. 183–197)

- Decentralized Exchange (DEX): A DEX is a DeFi application that enables authentication-free exchanges. Without the need for order management or

network monitoring by a third party, transactions on a DEX are instantly delivered to users' wallets. Among the various DEX options, UniSwap (token name UNI) is the most renowned.

- InsurTech: Through the use of blockchain technology, DeFi has greatly improved InsurTech. As an example, wallet balance protection against hacking is achieved by blockchain-based InsurTech. Insurance for assets built on the blockchain, both digital and tangible items, is another use.
- FinTech: FinTech has been similarly transformed by DeFi technology. DeFi-based FinTech seeks to revolutionize banking by using cutting-edge strategies such as universal access, cost reduction without sacrificing quality, and improved risk assessment, mitigation, and monitoring. FinTech services based on DeFi are especially beneficial to small firms.
- Stablecoins: A centralized management system is often in place for stablecoins, or tokens with fixed pricing. It was a novel idea to introduce stablecoins based on blockchain technology for transparency. Stablecoins are currently widely used in DEX platforms as liquidity pools and in DeFi projects.
- Lending and Borrowing: Similar to conventional bank-based interest systems, smart contracts allow individuals to lend and borrow money based on their balances without the need for a bank. Smart contracts and blockchain guarantee the lender's profits. AAVE and SushiSwap (token name SUSHI) are two noteworthy instances of Ethereum-based lending services.
- Saving: This application permits users to stake or lock their cryptocurrencies and earn profits from saving them.
- Asset Management: Asset management that is affordable for digital, physical, and blockchain-based assets is provided by DeFi. Using their cell phones, owners may track, manage, purchase, and sell all of their assets, which simplifies the asset management procedure.

3-2 DeFi real-life examples

The DeFi field has seen the emergence of numerous DeFi protocols that mimic traditional financial services and establish themselves as vital parts of a complex ecosystem that encompasses a range of noteworthy tokens and initiatives. It is essential to comprehend the working mechanics of these real-world DeFi protocols to appreciate their compatibility. The next section focuses on the various protocols used in the financial applications that were described earlier and have become more well-known in the DeFi market. Decentralized lending and borrowing, yield farming, stablecoins, decentralized exchanges (DEXs), and other financial services are all covered by these protocols. To accommodate varying user demands and preferences, each protocol offers a distinct set of features and benefits. Based on the unique applications of each DeFi protocol inside the DeFi domain, Figure 2 depicts the numerous DeFi protocols.

3-2-1 Synthetix

Synthetix is a DeFi protocol founded on the Ethereum blockchain, primarily designed to facilitate the trading of derivatives within the DeFi ecosystem. originally launched as a stablecoin–and has since pivoted to focus on derivatives,

becoming one of the largest and most successful platforms in this space. Synthetix's primary function is the generation of synthetic tokens, which are digital assets designed to mimic the price fluctuations of real assets. At now, these artificial tokens have the ability to track five different types of assets: different cryptocurrencies, inverse cryptocurrencies (which indicate short holdings), indices, commodities, and physical assets like gold.
Traders can easily transition between multiple asset classes with synthetic assets, such as transitioning from synthetic Gold (sXAU) to synthetic Ethereum (sETH), by circumventing regulatory restrictions. More investment choices and increased flexibility are offered by this feature. Popular synthetic assets provided by Synthetix include iBTC and iETH, which are designed to replicate the pricing of Ethereum and Bitcoin, respectively. Users can participate in the price movements of these assets without really owning them by holding these synthetic tokens.

- How does it work?

The Synthetix Network Token, or SNX, is the native token of Synthetix and backs all Synths. More Synths can be made depending on how costly SNX is. For reliable tracking of underlying asset values, Synthetix protocol synths rely on Chainlink's decentralized price oracles. Users need to obtain SNX tokens and deposit them on the Synthetix platform to interact with the protocol. Users get a Synth token, which stands for a certain asset, in exchange. To preserve the stability and security of the Synthetix platform, collateralization ratios of 750%, as determined by community governance, support all Synths created by SNX staking.

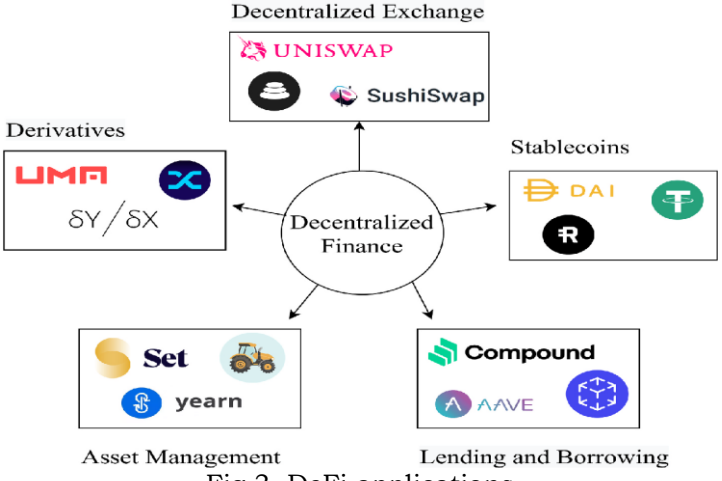

Fig 3. DeFi applications
Source: (Shah, Lathiya, Lukhi, Parmar, & Sanghvi, 2023, pp. 171–181).

Take into consideration, for example, a situation where a user wants to mint fake US dollars (sUSD). The user would receive about $133 worth of sUSD in return for depositing $1000 worth of SNX coins. This ratio illustrates Synthetix's collateralization strategy. A user incurs debt equal to the quantity of sUSD that needs to be destroyed to un-stake their SNX when they stake SNX and mints sUSD.

➢ Governance:

Originally, Synthetix was managed by the Synthetix Foundation, an Australian non-profit organization. Nevertheless, the regulation of the protocol is now divided among three distinct DAOs:

- Synthetix DAO: This DAO provides funding to individuals and groups that contribute to developing the protocol.
- Awards DAO: This DAO provides funding to community proposals that help guide the protocol in the right direction.
- Protocol DAO: This DAO manages funding for protocol upgrades and changes to Synthetix's smart contracts.

A few characteristics can distinguish the Synthetix Network. One important feature is that it allows users to convert Synths without needing counterparties. Furthermore, the Synthetix protocol specializes in extracting correct data from external sources, such as the value of the Japanese Yen or the price of companies like Tesla. Notwithstanding these advantages, there are still certain negative aspects. SNX staking requires a high over-collateralization ratio of 750%, which may be prohibitively expensive for many users and more costly than other DeFi protocols.

3-2-2 Maker DAI

The decentralized autonomous company MakerDAO is the one behind the algorithmic stablecoin DAI. DAI stands out from centralized stablecoins like Tether (USDT), which are governed by a single institution, due in large part to its high degree of decentralization. Users must deposit Ethereum-based assets into a smart contract in order to get DAI, and the contract uses the assets as security to keep DAI pegged to the US dollar.

➢ How does it work?

Several cryptocurrencies, including Ether (ETH), Basic Attention Token (BAT), USD Coin (USDC), Wrapped Bitcoin (wBTC), Compound (COMP), and others, can be used as collateral employing DAI. Collateralized Debt Positions, or CDPs, are smart contracts that are essential to the operation of DAI. The Single-Collateral Dai (SCD) architecture secures ETH as collateral within these contracts. This collateral operates as a buffer to produce DAI.

➢ Collateralized Debt Positions:

To receive DAI, users must initially create a Collateralized Debt Position (CDP) on the Maker Protocol and lock in collateral assets including Ether (ETH) or other recognized cryptocurrencies. The collateral that has been deposited acts as security for the loan, enabling customers to borrow money against their assets. The issued DAI is destroyed upon repayment. The protocol starts the liquidation procedure on the locked collateral to satisfy the debt obligation if the price of DAI drops too low.

To reduce the volatility of crypto collateral, DAI is in general terms, over-collateralized, which indicates that the required deposit amount is more than the

value of the borrowed DAI. DAI's linkage to the US dollar is maintained thanks to this excessive collateralization. Collateral of at least 150% of the loaned DAI is now required of users.

For instance, a user must lock Ethereum valued at at least $150 US dollars into the Maker Protocol's smart contract in order to acquire 100 DAI, which is equal to $100 US. Liquidation automatically begins if the collateral value is less than the created DAI's 150% level. The smart contract auctions off the backed collateral at liquidation at a discount of 3% and levies a penalty fee of 13%. As a result, of the original $150 in Ethereum collateral, about $100 will be put up for auction, and a total of $16 will need to be paid. The user will still have $34 worth of Ethereum and 100 DAI, which is worth $100.

- Governance:

MKR operates as the Maker Protocol's governance currency, providing its owners the authority to participate in votes on adjustments to the protocol's stability fees and risk limitations, among other changes. The Maker Protocol's direction and policies can be actively influenced by MKR holders thanks to this governance mechanism. MKR holders' capacity to influence the DAI supply is one of their most important roles. New DAI can be created through the burning of MKR tokens, however, DAI is susceptible to destruction by issuing more MKR tokens. The stability of the decentralized stablecoin is aided by this dynamic supply adjustment mechanism, which keeps the right amount of DAI in circulation.

Users seeking to protect their investments from Bitcoin's unpredictable fluctuations in prices can find a stable and dependable alternative in DAI, which offers the benefit of protecting against major price volatility in Bitcoin. Furthermore, because DAI is a cryptocurrency based on the Ethereum blockchain, it could potentially be effortlessly stored and transferred worldwide.

3-2-3 Uniswap

Uniswap is defined as an automated liquidity mechanism powered by a continuous product formula and implemented within an Ethereum blockchain system of non-upgradeable smart contracts. As a completely decentralized exchange technology, Uniswap is not owned or administered by a single entity. It is open-source software under the GPL license that allows users to list tokens on the exchange for free. Unlike most exchanges that make revenue through trading fees, Uniswap is dedicated to serving the public interest.

- How does it work?

Uniswap is based on two smart contracts: an Exchange contract and a Factory contract. The Exchange contract handles all token exchanges and trades, whilst the Factory contract is in charge of adding new tokens to the network. Uniswap distinguishes itself from other decentralized exchanges by employing the Constant Product Market Maker Model.

Each Uniswap smart contract, or pair, contains a liquidity pool that is composed of two ERC-20 token reserves. These pools are supported by liquidity providers,

who can participate by depositing the equivalent value of both tokens. Figure 4 depicts an abstract representation of the liquidity pool's operational mechanism. Uniswap's innovative approach determines token prices using the equation \(x \times y = k \), rather than directly matching buyers and sellers. When a user initiates a trade, the pair functions as an automated market maker, exchanging one token for another so long as the "constant product" formula is followed.

As an illustration, if Alice purchases 1 ETH for 300 USDT from the ETH/USDT liquidity pool, she increases the pool's USDT share while decreasing its ETH share, thereby raising the price of ETH. Following the transaction, the pool holds fewer ETH while the total liquidity (k) remains constant, maintaining proper pricing via this mechanism. Uniswap is the fourth-largest DeFi platform, with more than $3 billion in crypto assets maintained on its protocol, demonstrating its importance in the DeFi ecosystem.

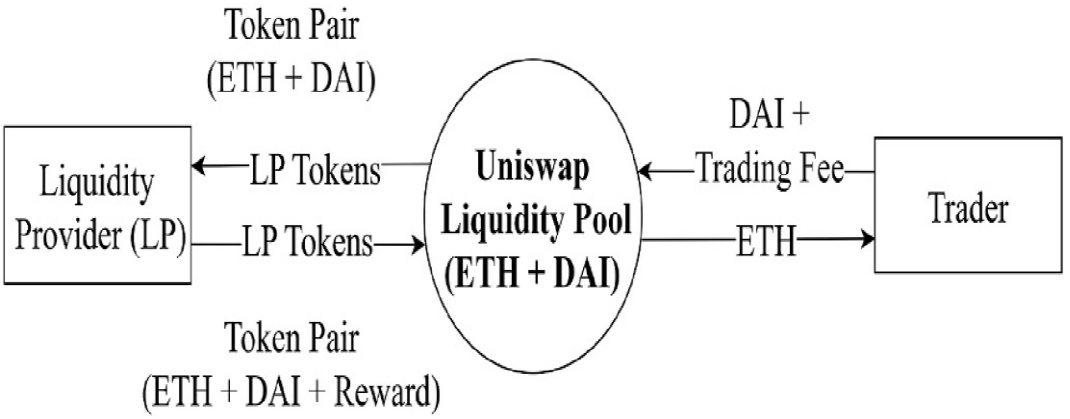

Fig 4. Uniswap Dual asset liquidity pool
Source: (Shah, Lathiya, Lukhi, Parmar, & Sanghvi, 2023, pp. 171–181).

3-2-4 Aave

Aave is an open-source, decentralized platform for the money market that provides a range of debt-based products. One of Ethereum's biggest liquidity protocols, Aave allows users to borrow money through flash loans, variable rate loans, and stable rate loans, and to deposit their digital assets into pools to earn interest. The protocol is compatible with an extensive range of ERC-20 tokens from the decentralized finance ecosystem in addition to ETH and some stablecoins like DAI and USDC. Additionally, Aave has extended its reach to Avalanche, Fantom, Harmony, and numerous other blockchain networks.

- How does it work?

The Lending Pool, which powers most of the protocol's operations, including deposits, loans, repayments, flash loans, withdrawals, and liquidations, is the central component of the Aave architecture (see Fig. 5). Derivatives known as aTokens are produced in exchange for token deposits into Aave, which give liquidity to Aave's token pools and start to earn interest. Usually, the value of the

deposited ERC-20 tokens determines the value of these aTokens, also known as Aave interest-bearing tokens.

Optimizing usage and managing liquidity risk are the goals of Aave's interest rate algorithm. The Utilization Rate (U), which represents the amount of capital available inside the pool, is used to calculate borrowing interest rates. Interest rates are kept low to promote borrowing in situations where capital is plentiful. On the other hand, high interest rates are applied in times of capital scarcity to encourage loan repayment and increase capital availability. Liquidity risk increases as the utilization rate approaches 100%. In response to this, Aave's interest rate curve is divided into two segments around an optimal utilization rate. The interest rate curve descends gradually up until this ideal rate, after which it increases rapidly.

Lending from Aave necessitates adequate collateral in the form of another asset to secure the loan because of the volatility of cryptocurrencies. For example, depositing more than $100 in another cryptocurrency is required to borrow $100 worth of DAI. This guarantees the liquidity of the pool in case borrowers are unable to return the loan or if the value of their collateral drops below a certain level. Fig. 5 illustrates the various interest rate models that can be applied to loans on Aave.

- Stable rate loan: Features a stable interest rate over time, akin to a traditional bank loan.
- Variable rate loan: Has a dynamic interest rate that varies according to demand and supply.

Chainlink analyzers provide all asset values to Aave, which bases interest rate determination on market conditions and the utilization rate of the liquidity pool. By staking and voting their tokens, owners of the Aave governance token are encouraged to oversee and grow the platform securely. This is in line with the completely decentralized autonomous organization (DAO) governance model that the Aave protocol has chosen.

3-2-5 Yearn Finance

An open-source, Ethereum-based automatic yield aggregation platform called Yearn Finance (YFI) was created to assist customers in getting the most out of lending their cryptocurrencies across a range of DeFi protocols. By allowing users to locate and switch to the highest yields on offer, Yearn Finance functions similarly to an Amazon marketplace, allowing users to maximize the returns on their cryptocurrency investments. Gas fees, trading fees, staking incentives, and lending interest can all produce these yields.

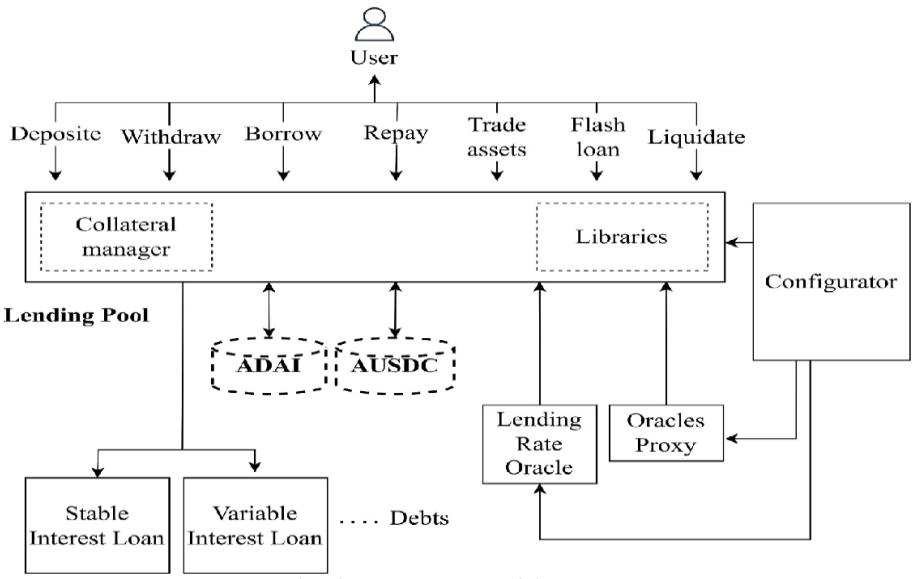

Fig 5. Aave V2 architecture
Source: (Shah, Lathiya, Lukhi, Parmar, & Sanghvi, 2023, pp. 171–181).

- How does it work?

Yearn Finance (YFI) operates as an open-source, Ethereum-based automatic yield aggregation platform that helps customers maximize earnings on cryptocurrency lending across several decentralized finance (DeFi) protocols. Yearn Finance, which operates similarly to an online marketplace, allows investors to select and switch to the most profitable yield prospects, thus increasing their Bitcoin investments. Gas fees, trading fees, staking incentives, and lending interest all generate yield.

The technology uses YFI's smart contracts implemented on the Ethereum blockchain to monitor and manage funds across connected decentralized exchanges, ensuring that they remain in the liquidity pools with the highest profits. Yearn Finance builds customized pools for each stablecoin, in which users deposit stablecoins and receive yield-bearing tokens known as yTokens in exchange. For example, depositing DAI yields yDAI. These pooled stablecoins can be transferred among a variety of lending protocols, increasing yield. Users can consume their respective yTokens to regain the underlying stablecoin and withdraw it, together with any earned interest. The protocol prioritizes using the same stablecoin for withdrawals, even if other stablecoins provide higher payouts.

Yearn Finance comprises of four core products:

- Earn: An aggregator of loans that transfers user assets between DeFi protocols like Compound, AAVE, and dYdX in real time. Earn makes sure consumers take advantage of the best returns by constantly altering the allocation in reaction to changing interest rates.
- Vaults: Based on market opportunities, these staking pools provide income. There are two types of Yearn Vaults: V1 and V2. V2 yVaults are capable of utilizing up to 20 strategies at once, whereas V1 yVaults only apply one strategy per vault. Each pool in these vaults represents a distinct yield-

maximizing approach created by Yearn's staff and community contributions.

- Zap: This functionality allows users to trade in and out of liquidity pools on the CurveDAO platform using stablecoins such as USDT, USDC, DAI, BUSD, and TUSD. It consolidates many deals into a single transaction, lowering costs and making the process easier for users.
- Cover: Offers insurance against financial losses related with various smart contracts and protocols on the Ethereum network.

Furthermore, Yearn Finance uses YFI tokens as its principal governance tokens, giving holders the ability to vote on protocol improvements and new ideas. (Shah, Lathiya, Lukhi, Parmar, & Sanghvi, 2023, pp. 171–181).

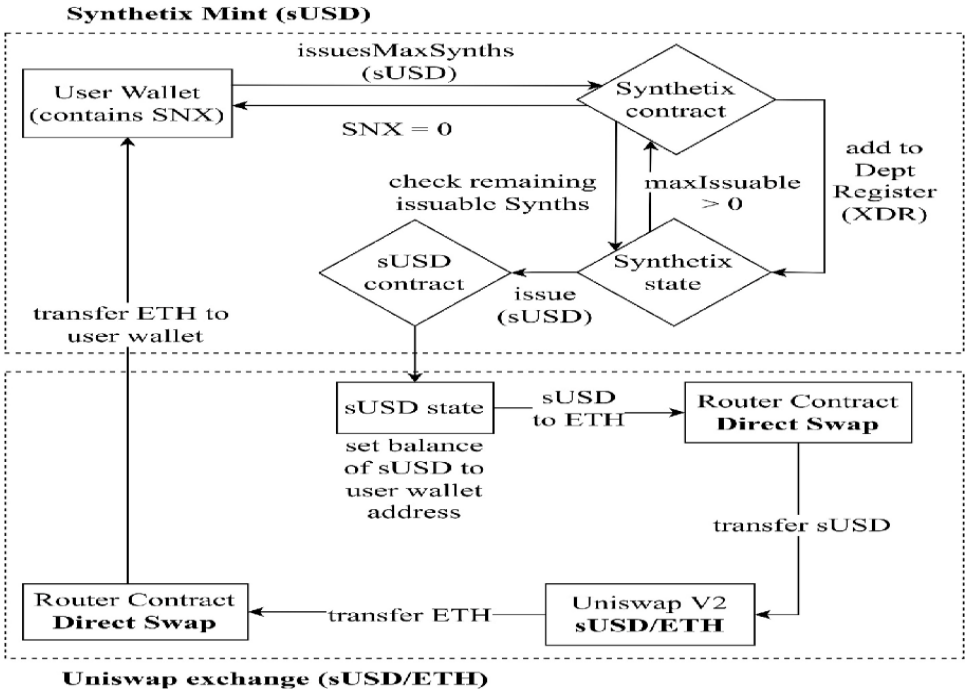

Fig 6. Synthetix and Uniswap interoperability
Source : (Shah, Lathiya, Lukhi, Parmar, & Sanghvi, 2023, pp. 171–181)

3-3 The Value of the DeFi

The Total Value Locked (TVL) indicates the total amount of money invested in decentralized finance (DeFi), which includes both individual initiatives and the larger DeFi ecosystem. Figure 7 depicts the total TVL performance from 2020 to the first quarter of 2023. Several factors influence the TVL, as indicated by the temporal changes depicted in the chart below. The significant growth in TVL witnessed in 2021 can be attributable to three main factors:

- Appreciation of Cryptocurrency Values: The TVL in DeFi is significantly influenced by the prices of underlying cryptocurrencies, as the value of TVL is strongly associated to the market value of these assets.

- Advancements in Financial Applications: TVL has increased as a result of the growth of programs that provide services including insurance, derivatives, lending and borrowing of digital assets, and crypto asset management.
- Widespread Adoption of Stablecoins: Stablecoins are now widely used within liquidity pools to facilitate trading and reduce volatility in the crypto markets. TVL in the DeFi sector has increased even more as a result of their function in stabilizing the market and drawing long-term investors.

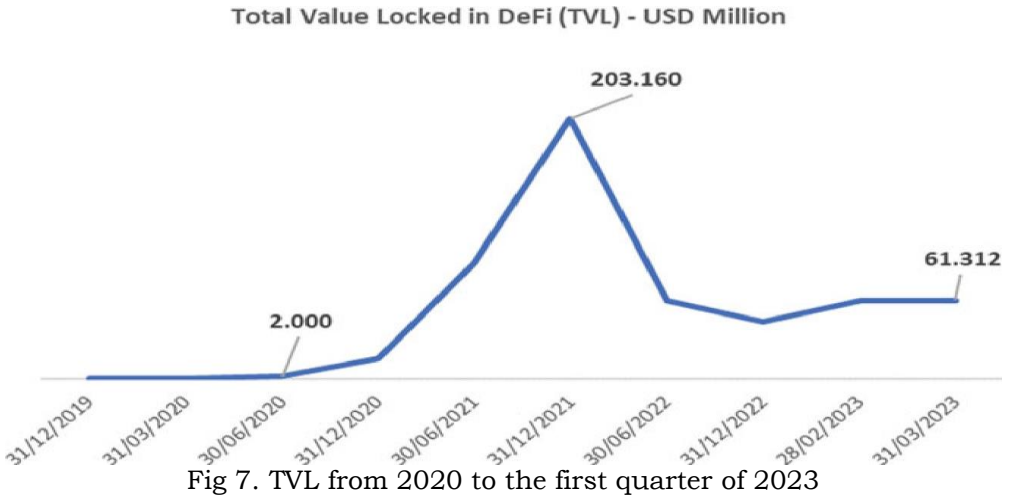

Fig 7. TVL from 2020 to the first quarter of 2023
Source: (Moro-Visconti & Cesaretti, 2023, pp. 303-304-305)

The dramatic increase in Total Value Locked (TVL) in 2021 was followed by a significant decline due to several critical events:

- Decline in Cryptocurrency Prices: The value of Ethereum (ETH) decreased by 70.4% within the first six months of 2022.
- Collapse of the Terra/Luna Ecosystem: In May 2022, the Terra/Luna ecosystem experienced a detrimental failure, resulting in a loss of $40 billion and further disagreeable cryptocurrency prices.
- Bankruptcy of FTX: The decline of FTX in November 2022 had profound repercussions. At its peak, FTX achieved a market capitalization of $3 trillion, underscoring the scale of its downfall.
- Domino Effect on DeFi Financial Players: These prominent corporations' defaults and bankruptcy sparked off a domino effect that affected other DeFi sector players and widened the hole in the market.

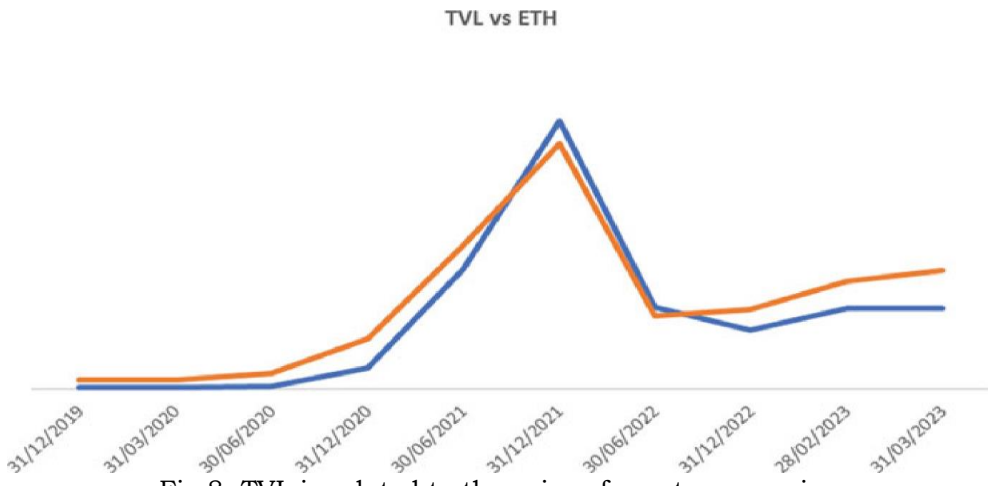

Fig 8. TVL is related to the price of cryptocurrencies
Source: (Moro-Visconti & Cesaretti, 2023, pp. 303-304-305).

The link between Total Value Locked (TVL) and cryptocurrency prices is substantial, as demonstrated in Figure 8, underscoring the DeFi ecosystem's reliance on the value of these digital assets. (Moro-Visconti & Cesaretti, 2023, pp. 303-304-305).

4- Conclusion

Decentralized finance (DeFi) has established itself as an unprecedented development in the realm of finance, utilizing blockchain technology to provide decentralized, transparent, and efficient financial services. The present article examined at the DeFi ecosystem's fundamental concepts, varied protocols, and implications, focusing on important applications including decentralized lending, automated market makers, and algorithmic stablecoins.

- Summary of Key Findings

According to the analysis, DeFi protocols that reconfigure financial interactions include MakerDAO, Uniswap, Aave, Synthetix, and Yearn Finance. MakerDAO uses collateralized debt positions to guarantee stablecoin stability, while Synthetix facilitates the production of synthetic assets. Uniswap's automated liquidity provisioning transforms decentralized exchanges, while Aave's money market protocols improve liquidity management. Yield optimization is automated across many DeFi systems by Yearn Finance.

- Implications

DeFi's decentralized nature promotes financial accessibility through the elimination of intermediaries and providing worldwide access to financial services. The universality of DeFi protocols promotes liquidity and efficiency, allowing for smooth asset exchange and yield optimization. Furthermore, DeFi's resiliency during market volatility demonstrates its potential to transform traditional finance while mitigating systemic risks associated with centralized systems.

- Research Limitations

The present investigation acknowledges certain limitations, including the influence of regulatory issues on the adoption and scalability of DeFi. User funds and platform stability are at risk due to smart contract vulnerabilities and market volatility. Furthermore, the accessibility and utility of DeFi may be hampered by its reliance on the transaction costs and network scalability of Ethereum.

- Suggestions for Future Research

Future studies might concentrate on resolving regulatory obstacles to encourage the widespread use of DeFi. Improving user trust and reducing risks require enhanced security measures and governance frameworks. Furthermore, investigating interoperability options for various blockchain networks may increase the usefulness and robustness of DeFi. Extensive research tracing the development of DeFi and its influence on financial markets would offer significant understanding of its scalability and sustainability.

To sum up, DeFi signifies a paradigm change toward inclusive and decentralized financial systems. As the ecosystem develops, removing obstacles related to regulations, improving security, and encouraging interoperability will be essential to achieving DeFi's goal of democratizing banking on a worldwide scale.

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