Deciphering DeFi

A Multi-Blockchain Perspective with Econometric Methods

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"Blockchain and DLTs"
(Cycle 39)

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Financial Services

Classical Finance (with Intermediaries)	• Decentralized Finance / DeFi • (with Smart Contracts)
Trade Finance and Liquidity Management (by Exchanges and Brokers)	• Swap, Liquidity Pools and Arbitrage • (by Automated Market Makers)
Deposit/Loan (by Banks)	• Lending/Borrowing • (by Automated Lending Protocols)
Payments International Money Transfer	• Account Abstraction and Ramp-off • Cross-Domain Asset Transfer (Bridging)
Reinsurance (by Assurers) "More Risk Exposure For More Income"	• Restaking (by Restaking Protocols) • "More Risk Exposure For More Income"

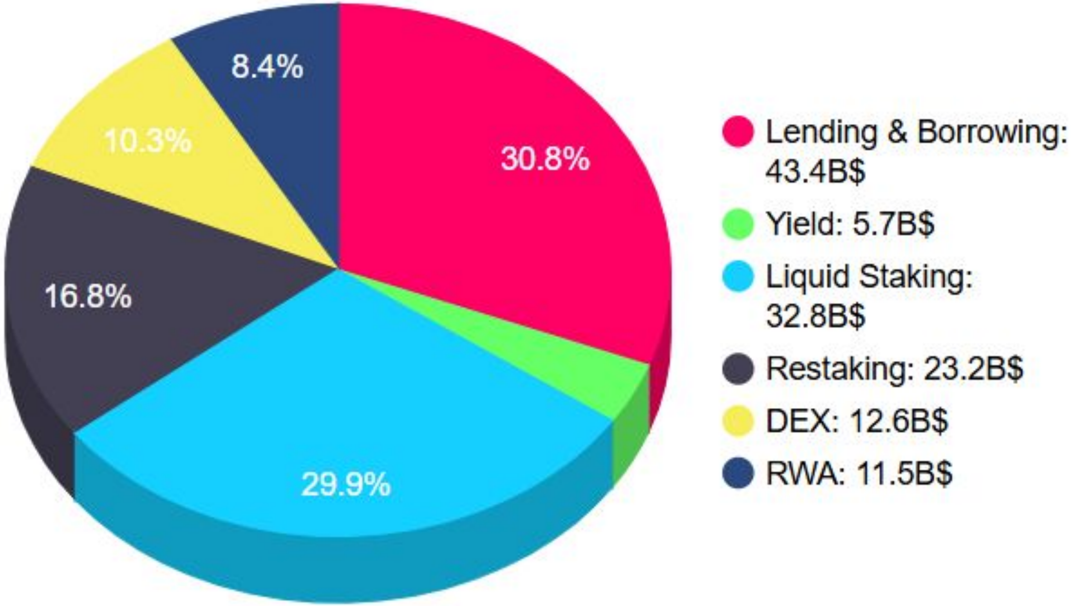
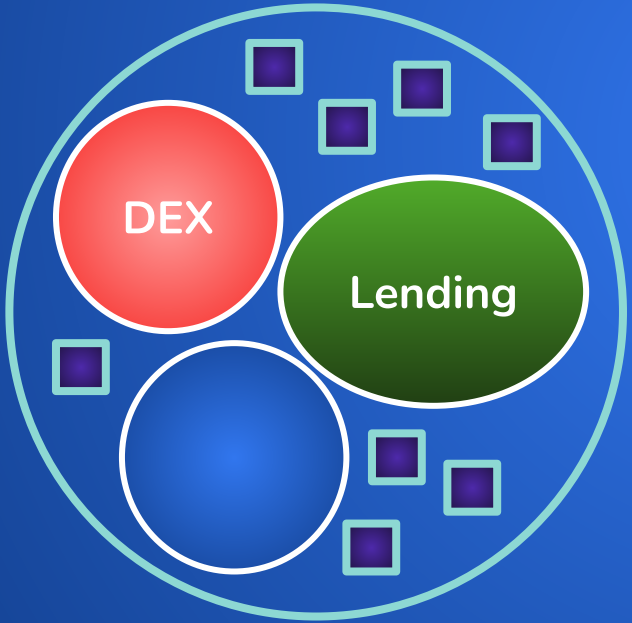


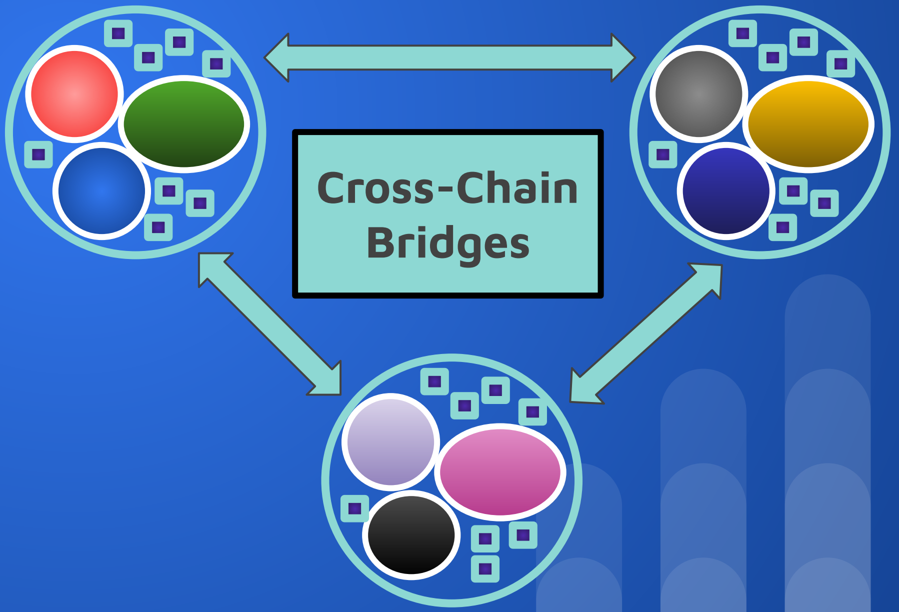
Fig. 1: The pie chart shows the liquidity in the decentralized finance by sector as of 7th June 2025.
Source: DefiLlama, https://defillama.com/ (Last Access: 7th June 2025)

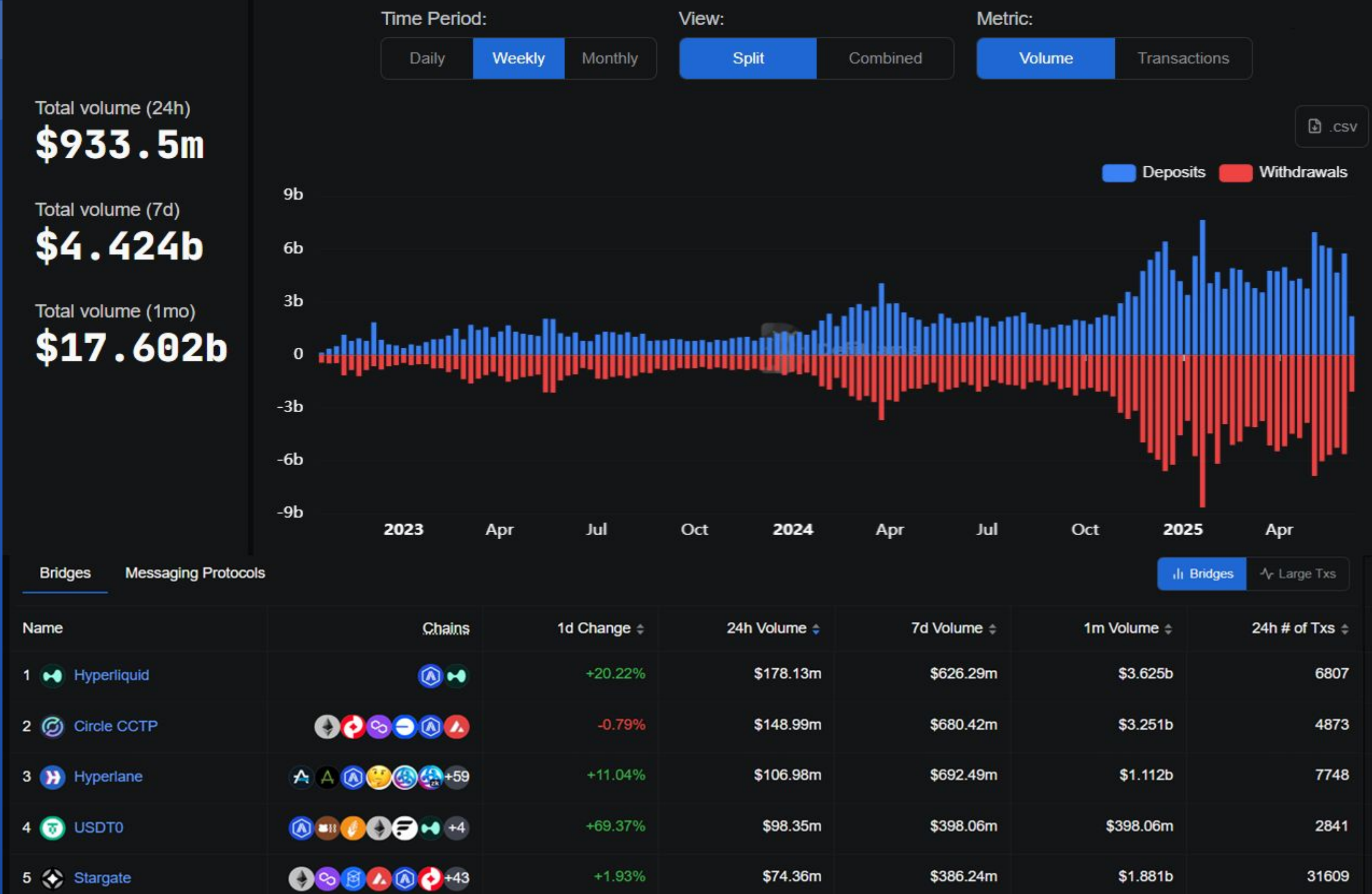
Understanding The New DeFi Ecosystem

2019
Ethereum

Today
Multi-DLT Environment







	Name	Chains	1d Change	24h Volume	7d Volume	1m Volume	24h # of Txs
1	Hyperliquid		+20.22%	$178.13m	$626.29m	$3.625b	6807
2	Circle CCTP		-0.79%	$148.99m	$680.42m	$3.251b	4873
3	Hyperlane	+59	+11.04%	$106.98m	$692.49m	$1.112b	7748
4	USDT0	+4	+69.37%	$98.35m	$398.06m	$398.06m	2841
5	Stargate	+43	+1.93%	$74.36m	$386.24m	$1.881b	31609

The figure shows the cross-chain asset transfer volume over time. It is used to underline the growing cross-chain landscape.

Source: DeFiLlama

Literature

- Cross-chain concepts are classified, studied, and analyzed well. E.g.: Cross-chain atomicity, rollup bridges, sidechains etc.

- DeFi service models are classified, studied, and analyzed well. E.g.: Empirical studies on AMMs, lending platforms etc.

- The financial impact of cross-chain activities over DeFi use-cases is understudied.

- Increasing cross-chain complexities should be integrated to the current DeFi designs and models to be compatible with the multi-blockchain future.

Gap, Scope and Contribution

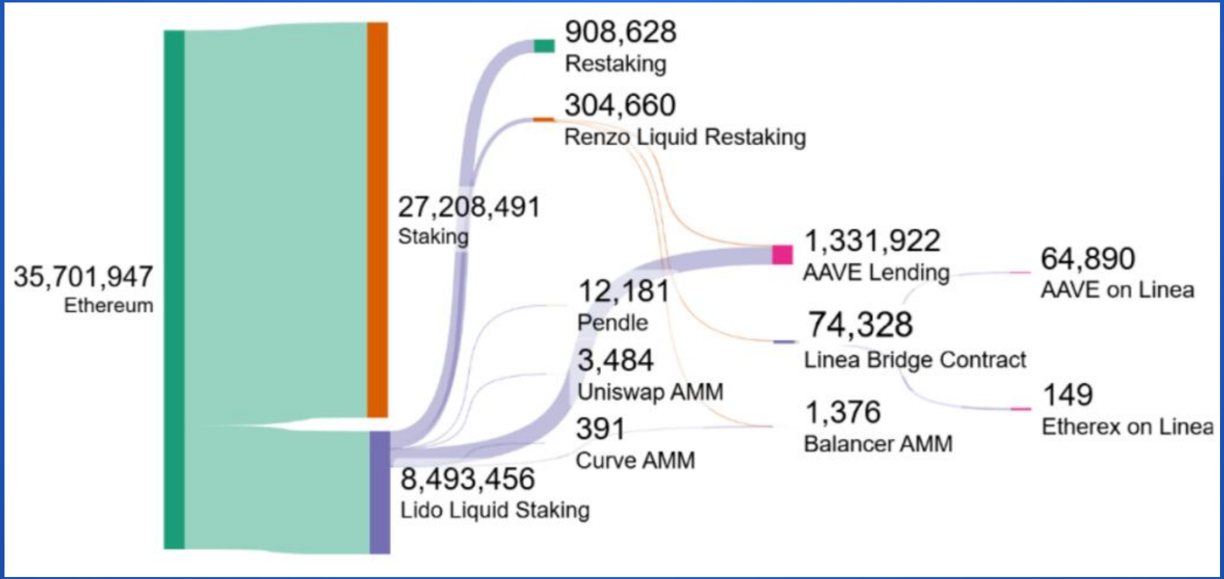
This doctoral research aims to:

- Investigate the DeFi use-cases,
- Investigate multi-blockchain components/variables,
- Extend the frontline of the state-of-the-art.

- The research focuses on:
    - 0) DeFi and Bridge Protocols Overall
    - 1) Cross-Chain Arbitrage Detection
    - 2) Financial Dynamics of Re-staking Service
    - 3) DeFi Lending Model Risk Models
      in Multi-Blockchain Environment

Interconnectedness Of DeFi Services

- **The DeFi ecosystem is connected.**
  We should approach comprehensively.
- **It is a leveraged economy.**



Research Question 0

What is cross-chain interoperability?

How can we assess the financial impact of cross-chain activities on DeFi protocols?

Research Question 1

To what extent is cross-chain arbitrage profitable by utilizing multi-blockchain bridges?

Research Question 2

What are the dynamics of re-staking service and liquid-restaking protocol revenue?

Research Question 3

Do cross-chain activities have a significant impact on the automated lending markets? How can we model it?

Empirically Proven Hypotheses

Hypothesis 1

"As the number of required hops increases, the probability of successfully executing the <u>cross-chain arbitrage</u> decreases significantly."

Hypothesis 2

"The revenue of a <u>liquid-restaking protocol</u> have significant and positive relationship with the multi-chain asset deployment."

Hypothesis 3

"A significant increase in <u>cross-chain bridge volume</u> indicates a subsequent change in the performance of <u>automated lending protocols</u>."

Data & Methodologies

Cross-Chain Arbitrage

Flipside Crypto
01/09/2023
31/08/2024

12 Networks
≈2.5B Swaps
≈35M Bridge

Developed an multi-hop SDA detection algorithm.

Re-staking Dynamics

The Graph, Etherscan, Dune Analytics
24/01/24 - 17/04/25

EigenLayer on Ethereum
Renzo on 6 Networks

OLS Regression, Granger Causality, Random Forest
Variables: Revenue, TVL, Users, LRT price, Tokenization Events etc.

Lending & Bridge

The Graph, DeFiLlama
Blockchain Explorers
10/09/23 - 01/01/25

9 Networks, 15 Protocols
53 Bridges

Fixed Effects Regression
Variables: Bridge Volume, TVL, Users, APY Rates, Cross-Chain Hacks etc.

Research Design

Exploratory Survey

"Connecting Distributed Ledgers: Surveying Novel Interoperability Solutions in On-chain Finance"

We first explored bridges and their potential impact on DeFi services.
Then conduct empirical research accordingly.

Empirical (Main) Part

AMMs and Arbitrage

"Bunny Hops and Blockchain Stops: Cross-Chain MEV Detection With N-Hops"

Restaking and Risks

"Financial Dynamics and Interconnected Risk of Liquid Restaking"

Multi-Chain Lending

"Interoperability Effects: Extending DeFi Lending Risk Models to Multi-Chain Environments"

Paper Status

Exploratory Survey

Conditionally Accepted to Financial Innovation journal (Q1)

Empirical (Main) Part

AMMs and Arbitrage

Published at

BRAINS2025

(Zurich)

Restaking and Risks

Pre-published.

Submitted to an IEEE conference.

Multi-Chain Lending

Pre-published.

Submitted to an IEEE conference.

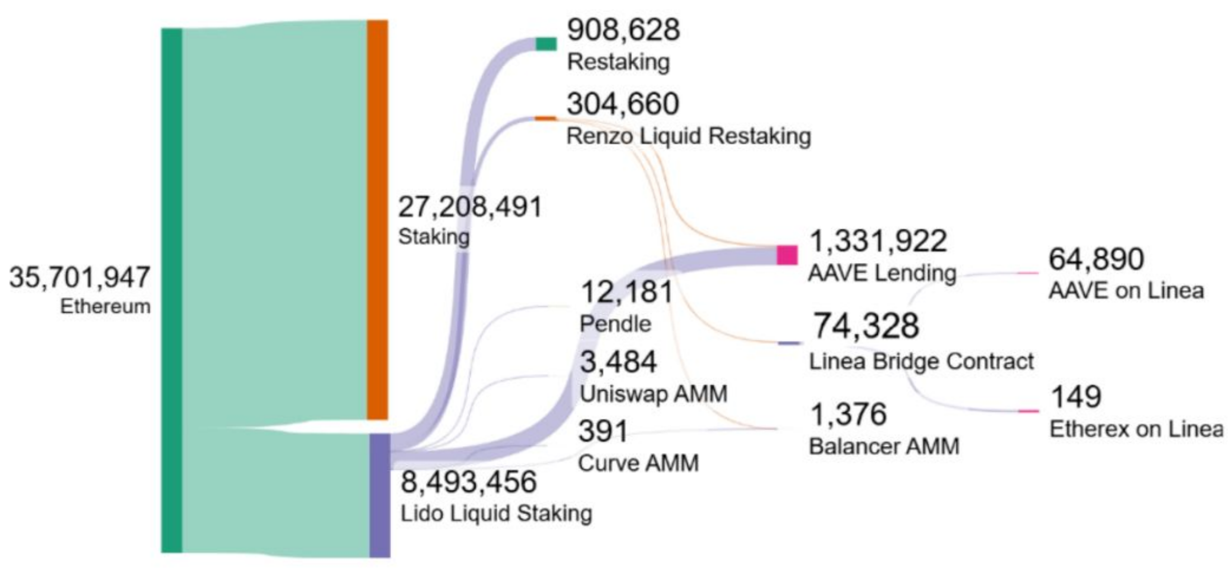
Current Status

- Data, R-Python code, and method details are public on Github. *https://github.com/EconoDLT*

- *"Financial Dynamics and Interconnected Risk of Liquid Restaking"* had a significant impact across Aave Forum, LinkedIn, X (Twitter).

- The KelpDAO hack on 18 April 2025:
    - A loss cascade happened across connected DeFi protocols.
    - This was what we exactly predicted, mapped, and quantified 3 weeks ago.

- **Expanding a DeFi service beyond the native chain, by utilizing bridges, creates new attack vectors and increase cascading risk.**
- **The KelpDAO Hack:**
  LRT > Restaking > LST > Staking > Network
- **This was the attack vector we mapped and quantified.**



Andre Cronje @AndreCronjeTech · Apr 18

We are continuing to investigate the L0/rsETH incident, initial reports seem to indicate a private key compromise/bad config allowed ~200m worth of rsETH to be stolen, this was then deposited into Aave to borrow ETH (since rsETH has insufficient liquidity). a) the position is

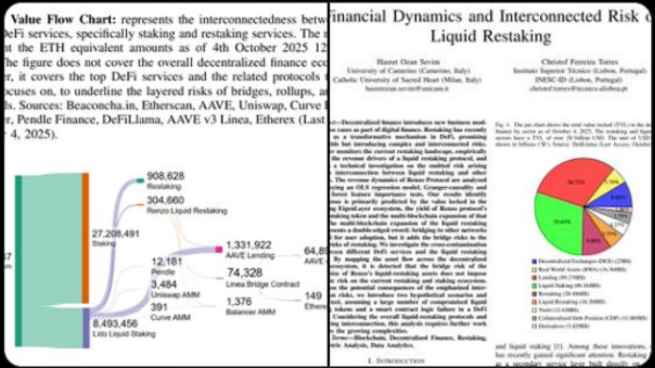
Show more

> **flyingtulip.com** @flyingtulip_ · Apr 18
>
> ETH PUT holder update.
>
> Available liquidity in Aave ETH dropped below the minimum liquidity threshold. All ETH was withdrawn. The system prioritizes liquidity above yield. No action required.

24 · 56 · 326 · 160K

HarbingerLink
@HarbingerLinky

This exact risk of bridged liquid restaking tokens was pointed out by a group of researchers. Impressive that they accurately pointed out the cascading impact.
arxiv.org/pdf/2604.03274



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Krzysztof Gogol · 1st
DeFi & Digital Assets | Helping RWAs Trade, Not Break | Vaults • DEX ...
1w •

⚠️ Liquid restaking is not just yield. It is leverage on top of leverage - across chains ...more

Dynamics and Interconnected Risk of Liquid Restaking • 10 pages

Financial Dynamics and Interconnected Risk of Liquid Restaking

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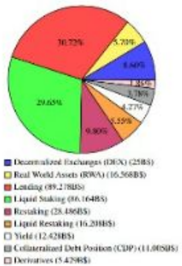
arXiv:2604.03274v1 [q-fin.GN] 23 Mar 2026

***Abstract*—Decentralized finance introduces new business models and use cases as part of digital finance. Restaking has recently emerged as a transformative mechanism in DeFi, promising extra yields but introducing complex and interconnected risks. The paper monitors the current restaking landscape, empirically analyzes the revenue drivers of a liquid restaking protocol, and conducts a technical investigation on the emitted risk arising from the interconnection between liquid restaking and other protocols. The revenue dynamics of Renzo Protocol are analyzed by employing an OLS regression model, Granger-causality and random forest feature importance tests. Our results identify that revenue is primarily predicted by the value locked in the underlying EigenLayer ecosystem, the yield of Renzo protocol's liquid restaking token and the multi-blockchain expansion of that token. The multi-blockchain expansion of the liquid restaking token presents a double-edged sword: bridging to other networks is crucial for user adoption, but it adds the bridge risks to the existing risks of restaking. We investigate the cross-contamination risk between different DeFi services and the liquid restaking protocol. By mapping the asset flow across the decentralized finance ecosystem, it is detected that the bridge risk of the current size of Renzo's liquid-restaking assets does not impose a systemic risk on the current restaking and staking ecosystem. To address the potential consequences of the emphasized interconnection risks, we introduce two hypothetical scenarios and a stress test, assuming a large number of compromised liquid restaking tokens and a smart contract logic failure in a DeFi protocol. Considering the overall liquid-restaking protocols and the growing interconnection, this analysis requires further work to explore the growing complexities.**

***Index Terms*—Blockchain, Decentralized Finance, Restaking, Econometric Analysis, Data Analytics.**

Fig. 1. The pie chart shows the total value locked (TVL) in the decentralized finance by sector as of October 4, 2025. The restaking and liquid-restaking sectors have a TVL of over 28 billion USD. The unit of USD amount is shown in billions ('B'). Source: DefiLlama (Last Access: October 4, 2025)



I. Introduction

The landscape of digital finance is undergoing a rapid transformation, continuously accelerated by a wave of open innovations. Within this fast-evolving landscape, innovation is constantly seeding new business models and expanding the use cases for different financial technologies. The primary example of this shift is the rise of decentralized finance (DeFi), which has emerged as the main financial application of blockchain and distributed ledger technologies (DLTs). By leveraging smart contracts, DeFi is involving new use-cases, services and business models on the DLTs from lending and borrowing to yield-bearing assets.

Since the Ethereum network has switched its consensus mechanism to proof-of-stake (PoS) from proof-of-work (PoW), we have witnessed innovative use cases such as staking and liquid staking [1]. Among these innovations, restaking has recently gained significant attention. Restaking functions as a secondary service layer built directly on top of the foundational process of the core consensus mechanism for PoS blockchains, by enabling the reuse of already staked assets to secure additional applications and earn extra rewards. For example, on EigenLayer as a pioneer and leading restaking protocol, staked assets can be restaked to validate and secure other applications or services that benefit from Ethereum's decentralized infrastructure. This validation service is called *actively validated services* (AVSs) [2]. By contributing to an AVS, restakers seek an additional yield in exchange with risking the staked assets [3]. Liquid restaking protocols (LRPs) are platforms that allow users to earn compounding rewards by securing multiple blockchain services with their staked assets, while issuing liquid restaking tokens (LRTs) that represent this restaked position and its accrued yield, enabling the tokens to

1 / 10

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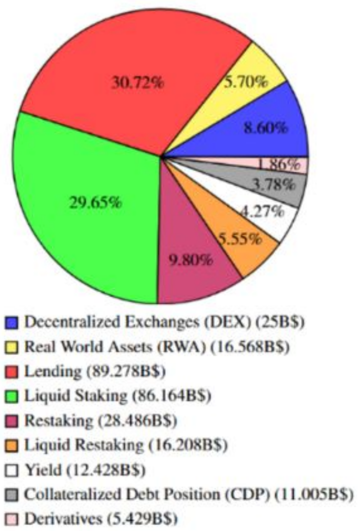
Jerome de Tychey
@jdetychey

Financial Dynamics and Interconnected Risk of Liquid Restaking... March 26 by Hasret Ozan Sevim @Unicatt_en & @ChristofTorres
It unpacks the revenue drivers and hidden contagion risks (with a focus on @RenzoAI)
A good read while you browse into the KelpDAO exploit; a🧵 👇 (🧶1/7)

Fig. 1. The pie chart shows the total value locked (TVL) in the decentralized finance by sector as of October 4, 2025. The restaking and liquid-restaking sectors have a TVL of over 28 billion USD. The unit of USD amount is shown in billions ('B'). Source: DefiLlama (Last Access: October 4, 2025)



6:01 PM · Apr 21, 2026 · **293** Views

1 2

aave **rsETH incident — 2026-04-18**
Risk

ApuMallku Apr 19

I am not here to make a grave dance or point fingers. However, we must confront the reality that we could have done things differently. I truly believed we had learned our lesson from the Curve drama that shook this protocol to its core not long ago. This rsETH incident is even more serious because it strikes at the heart of our technical safety during a time of extreme vulnerability for our risk infrastructure.

How can we prevent this from happening again? We must acknowledge that Aave Guardians, while incredibly diligent, operate on human timelines. In a dark forest where malicious actors move at the speed of the mempool, relying on manual intervention is no longer a viable security strategy for a protocol of this scale. We need to prioritize the development and integration of on-chain agents that can act autonomously to halt withdrawals or freeze caps when specific malicious patterns are detected. If we cannot defend at the speed of code, we are simply waiting for the next exploit. Maybe the implementation of a withdrawal cooldown for everyone? I know it could sound too drastic, but for me having a huge amount of bad debt is way worse.

It appears listing rsETH in its current form was a mistake or at least a failure of conservative parameterization. It is particularly frustrating to see that the recent study titled Financial Dynamics and Interconnected Risk of Liquid Restaking 49 specifically highlighted these type of systemic risks just last month. The caps were not safely placed, and the protocol is now paying the price in reputation.

Having to use the Umbrella module assets is a path born of desperation. This should never be viewed as a standard buffer or a “cost of doing business.” If Aave continues to incur bad debt through aggressive listings, it will eventually break the confidence of our most loyal depositors and future module participants. Once that trust is gone, no amount of collateral can bring it back.

I am calling on our risk providers to do better. I would much rather see Aave host fewer assets and grow at a measured, sovereign pace than provide endless options that compromise our fundamental security. DeFi has been battered since the start of the year and confidence is crashing across the entire ecosystem.

Resilience over convenience.

11

Apr 19
2 / 153
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Conclusion

- This thesis investigates the paradigm shift from single-chain to multi-chain architecture in DeFi, analyzes the multi-chain impact.

- Each paper focuses on one connected DeFi service/use-case.

- All papers and results converge into core insights:
  - Cross-chain interoperability and multi-chain landscape become a driving force for all DeFi services.
  - The variety of business and revenue opportunities increase; along with the new complexities and layered risks.
  - Each DeFi service and protocols should adopt cross-chain models and variables for more efficiency and safety.

Timeline

2023 - 2024	2024 - 2025	2025 - 2026 (Currently)	Post-PhD
Organizing Research	Data Collection	Submitting Results To Academic Journals	Extending The Scope Of The Project
Literature Review	Performing Tests	Presenting In More Academic Events	Deploying Products
Method Selection	Evaluating Results		
Crystalizing Technical Skill	Reconsidering Hypothesis		

Another sub-research ongoing:
*"Oracle Extractable Value
Across Different Blockchains"*

Thank you.

hasretozan.sevim@unicam.it

“Connecting Distributed Ledgers: Surveying Novel Interoperability Solutions in On-chain Finance”

```
M1: Pooled OLS
TVL_t = β0 + β1(NetVolume)_t + β2(TxCount)_t + β3(GasPrice)_t +
β4(ETH)_t + ϵt

M2: Pooled OLS
Revenue_t = β0 + β1(NetVolume)_t + β2(TxCount)_t + β3(TVL)_t +
β4(GasPrice)_t + β5(ETH)_t + ϵ_t

M3: FE Chain-Type
Revenue_i,t = α_i + λ_t + β1(NetVolume)_i,t + β2[NetVolume ×
L2]_i,t + β3[NetVolume × AltL1]_i,t + β4(TxCount)_i,t +
β5(TVL)_i,t + ϵ_i,t

M4: FE Network
Revenue_i,t = α_i + λ_t + β1(NetVolume)_i,t + β2(TxCount)_i,t +
β3(TVL)_i,t + ϵ_i,t

M5: FE Protocol
Revenue_i,t = α_p,c + λ_t + β1(NetVolume)_i,t + β2[NetVolume ×
Across]_i,t + β3[NetVolume × Hop]_i,t + β4(TxCount)_i,t +
β5(TVL)_i,t + ϵ_i,t
```

Table 13: The table includes regression results for all models. Standard errors are in parentheses. Coefficients are rounded to appropriate precision. Stargate is assumed as the base protocol in M5. Ethereum is assumed as the base network in M3. Significance levels are denoted by: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $^{\cdot}$ $p < 0.01$.

	Pooled OLS (Log-Log)		**Fixed Effects (Log-Log)**		
	M1: TVL	**M2: Revenue**	**M3: Chain-Type**	**M4: Network**	**M5: Protocol**
Intercept	20.5018 (0.282)***	5.5105 (3.136)$^{\cdot}$	-	-	-
NetVolume	-0.0022 (0.001)***	-0.0003 (0.001)	-0.0035 (0.001)*	-0.0194 (0.003)**	-0.0152 (0.003)**
NetVolume:L2	-	-	-0.0002 (0.003)	-	-
NetVolume:AltL1	-	-	-0.0154 (0.001)***	-	-
NetVolume:AcrossV2	-	-	-	-	0.0495 (0.004)***
NetVolume:Hop	-	-	-	-	0.0216 (0.004)***
TxCount	-0.0323 (0.006)***	0.4847 (0.0139)***	0.4763 (0.075)**	0.4492 (0.102)**	0.7578 (0.003)***
TVL	-	-0.5079 (0.149)***	0.4478 (0.304)	0.3819 (0.241)	0.1613 (0.020)***
GasPrice	0.0181 (0.007)**	0.0222 (0.012)$^{\cdot}$	-	-	-
ETH	-0.0907 (0.037)*	1.1676 (0.096)***	-	-	-
Adjusted R-squared	0.2141	0.7381	0.8228	0.8036	0.8598
Within R-squared	-	-	0.0332	0.2702	0.6461
Observations	638	638	3825	3822	5098

"Financial Dynamics and Interconnected Risk of Liquid Restaking"

```
Revenue_t = β0 + β1(TVL0)_t + β2(TVL1)_t + β3(TVL2)_t +
β4(Yield)_t + β5(Premium)_t + β6(Share)_t + β7(APY)_t +
β8(Events)_t + β9(ETH)_t + β10(TxFee)_t + β11(FGI)_t + ϵ_t
```

TABLE III
OLS REGRESSION RESULTS

	Model 1	**Model 2 (t-1)**	**Model 3 (t-2)**
(Intercept)	-14.78*** (4.55)	-15.42*** (4.13)	-11.94** (4.70)
TVL0	0.98*** (0.21)	1.00*** (0.19)	0.89*** (0.22)
TVL1	-1.02 (1.86)	-0.17 (1.68)	-1.36 (1.90)
TVL2	0.08*** (0.02)	0.08*** (0.02)	0.07*** (0.02)
Yield	3.82*** (1.08)	10.32*** (0.98)	0.09 (1.10)
Premium	0.03 (0.10)	-0.01 (0.09)	-0.06 (0.11)
Share	0.07*** (0.01)	0.07*** (0.01)	0.06*** (0.01)
APY	0.21* (0.12)	0.23* (0.10)	0.09 (0.12)
Events	-0.91 (0.76)	-0.34 (0.69)	-0.78 (0.78)
ETH	0.86 (1.97)	1.23 (1.78)	-1.55 (0.78)
TxFee	0.42 (0.54)	0.23 (0.48)	0.02 (0.55)
FGI	0.02* (0.01)	-0.02* (0.01)	0.02 (0.01)
Observations	452	451	450
R-squared	0.314	0.438	0.275
Adj. R-squared	0.297	0.424	0.257

Note: This table presents the results of the OLS regressions with different lag structures. The dependent variable is $Revenue_t$. The written values represent coefficients while statistical significance levels are shown with stars. Standard errors are reported in parentheses. Significance levels: $\cdot$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

“Bunny Hops and Blockchain Stops: Cross-Chain MEV Detection With N-Hops”

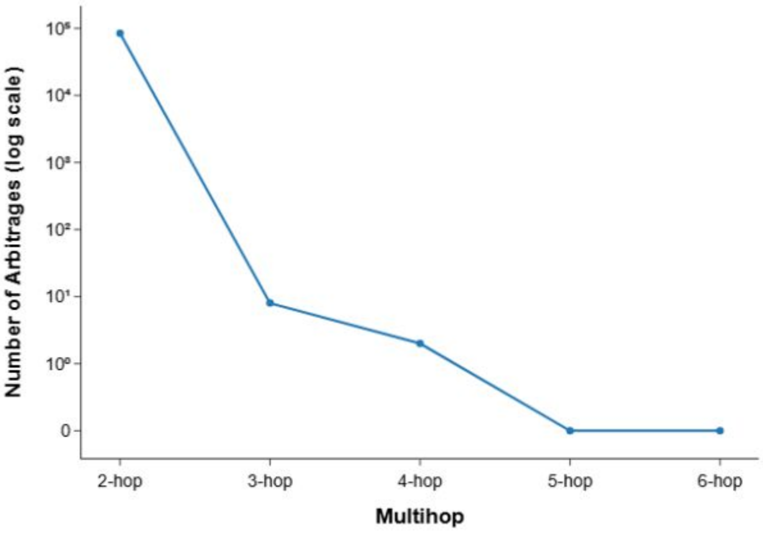

TABLE I
SUMMARY OF THREE-HOP ARBITRAGE TRANSACTIONS

Chain Path	Dur.(s)	Tokens	Profit($)
Base→Eth→Base	646	USDC/BAL	32.78
Base→Opt→Base	490	HOP/WETH	0.43
Arb→Opt→Base	311	ARB/WETH/HOP	-255.07
Opt→Base→Arb	466	WETH/HOP	264.04
Base→Avax→Base	448	USDC/axlUSDC	21.40
Arb→Poly→Arb	412	USDT/USDC/WBTC	-0.17
Blast→Arb→Eth	458	WETH/ezETH	-8.17
Poly→Arb→Poly	242	WMATIC/WBTC/WETH	-0.02

“Interoperability Effects: Extending DeFi Lending Risk Models to Multi-Chain Environments”

```
(Perf)_t,i = α + β1(BridgeVolume)_t,i + β2(BridgeVolume)_t,i
(L2)_i + β3(BridgeVolume)_t,i (AltL1)_i + β4(Liquidation)_t,i +
γ1(CER)_t,i + γ2(Withdraw)_t,i + γ3(ETH)_t,i + γ4(GasPrice)_t,i
+ γ5(ETH APY)_t,i + γ6(Stablecoin_APY)t,i + γ7(FGI)_t +
γ8(BridgeHack)_t + γ9(Integrations)_t + γ10(Mainnet)_t + ϵ_t
```

TABLE III
PANEL DATA REGRESSION RESULTS

	Model 1 (TVL)	Model 2 (TR)
BridgeVolume	-0.0615** (0.0207)	0.1385*** (0.0328)
BridgeVolume:L2	0.1497*** (0.0251)	-0.1351*** (0.0397)
BridgeVolume:AltL1	-0.0094 (0.0254)	-0.2731*** (0.0402)
Liquidate	0.0005 (0.0023)	0.0169*** (0.0037)
CER	0.0309** (0.0106)	-0.0023 (0.0167)
Withdraw	0.2145*** (0.0079)	0.3231*** (0.0126)
Integrations	-0.1796*** (0.0505)	-0.2241** (0.0799)
Mainnet	0.0217 (0.1074)	-0.0912 (0.1698)
BridgeHack	-0.0168 (0.0758)	0.3274** (0.1199)
volETH	0.1712 (0.4640)	-2.034** (0.7337)
ETH_APY	-0.0109 (0.0198)	-0.1945*** (0.0312)
Stablecoin_APY	0.0517*** (0.0029)	0.1203*** (0.0046)
GasPrice	-0.0438 (0.0313)	-0.0662 (0.0495)
FGI	0.0053*** (0.0005)	0.0084*** (0.0008)
Observations	2421	2421
R-squared	0.6297	0.7026

Note: This table includes estimates of two panel regression models performed on TVL and TR as dependent variables. The written values represent coefficients while statistical significance levels are shown with stars. Standard errors are reported in parentheses. Significance levels: $\cdot$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$