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TRANSACTION STRUCTURE AND ACTIVITY CONCENTRATION IN THE STELLAR BLOCKCHAIN REGISTER

Abstract

The purpose of the article. The aim of this article is to examine the Stellar payment network in terms of transaction dynamics over time, asset structure, and the concentration of participant activity using transactional data obtained from the public blockchain ledger.

Methodology. The empirical investigation was conducted using a sample of 1,000 consecutive ledgers retrieved from the Stellar public ledger. The data were processed in the Python environment with the use of the pandas, matplotlib, and networkx libraries. Quantitative analytical methods were applied, including measurements of the number of operations, asset structure, transaction value distribution, and concentration analysis based on Lorenz curves, the Gini coefficient, and network centrality metrics within the transaction graph.

Results of the research. The obtained evidence indicates a high level of activity concentration within the Stellar network – a small number of addresses account for the dominant share of transaction volume. The network structure exhibits a core–periphery pattern, in which a narrow group of highly central nodes plays a crucial role. The observed pattern reflects a structure typical of open blockchains – numerous marginal accounts and a small core that is strategically important for system liquidity. The findings may serve as a basis for further research on the decentralization and stability of payment systems built on blockchain technology.

Keywords: blockchain, network analysis, payment networks, decentralization, DeFi

JEL Class: O33, L86, C88



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Introduction

The growth of global economic interconnections has led to an intensification of cross-border financial flows. Of particular importance are international money transfers, which have traditionally been processed through the SWIFT system. Although SWIFT has remained a central component of international banking for decades, access to the network and the surrounding payment infrastructure can be restricted as part of financial sanctions (Cipriani et al., 2023).

An alternative to this traditional model is blockchain-based solutions such as Stellar. Unlike SWIFT, which serves only a messaging function, Stellar integrates both the communication and settlement layers, enabling near-instant transaction finality and direct value transfer between participants (Lokhava et al., 2019). The Stellar network, developed by the Stellar Development Foundation since 2015, uses its native currency XLM and allows the issuance of tokens linked to fiat currencies and other assets. Its key innovation is the Stellar Consensus Protocol (SCP), a federated Byzantine agreement mechanism that enables consensus to be achieved under an open membership model (García-Pérez & Schett, 2020).

The operation of the Stellar network is based on a public distributed ledger, which can be compared to a digital accounting book. Each ledger records the network state resulting from a set of validated transactions, each of which may contain one or more operations. Accepted transactions and their constituent operations are incorporated into successive ledgers, which close approximately every five seconds (Lokhava et al., 2019). This process is facilitated by the SCP consensus mechanism, which differs from the energy-intensive Proof-of-Work methods used, for instance, in Bitcoin. In SCP, network participants – known as validating nodes – independently choose sets of other nodes they trust (so-called quorum slices). These form broader groups (quorums) that collectively agree on the ledger state resulting from submitted transactions. Only when a sufficient number of trusted nodes reaches agreement is a new ledger closed. As a result, Stellar enables fast and secure payment settlements while maintaining open participation and eliminating the need for mining mechanisms (Gaul et al., 2019).

Stellar has applications across various domains, including retail payments, remittances, asset tokenization, and token-based banking (Shamsi et al., 2022). Importantly, this project – like other blockchain-based solutions such as Ripple – does not seek to eliminate traditional financial institutions but rather to integrate them with a new payment infrastructure. Consequently, Stellar represents an intriguing case study combining technological innovation with practical applications in the financial sector.

The aim of this article is to examine the Stellar payment network in terms of transaction dynamics over time, asset structure, and the concentration of participant activity using transactional data obtained from the public blockchain ledger. The research design includes measurements of transaction volume dynamics and the number of operations, assessment of asset

structure, and analysis of participant concentration using Lorenz curves and the Gini coefficient. Particular attention is devoted to network topology and the identification of key nodes. The resulting evidence is compared with the findings of previous studies to assess Stellar's potential as a global payment infrastructure.

Research Method

The empirical study was based on an analysis of transactional data from the public Stellar ledger, which constitutes the technological foundation of the network's operation. Each ledger records account balances and validated transactions together with their constituent operations. Owing to the open access provided through the Horizon interface, it is possible to retrieve complete ledger sequences and analyze them using any analytical tools. The source data were collected using a custom Node.js script. This script employed the official stellar-sdk library to communicate with the Horizon server, axios for handling HTTP requests, and the fs module for streaming data into CSV files. The solution allows both downloading a specific range of ledgers and retrieving the latest n ledgers. The script implements an iterative mechanism for traversing all operations within each ledger, with pagination and filtering options. Using this approach, a complete operation-level dataset was gathered for a sample of 1,000 consecutive ledgers dated before 13 September 2025. The script recorded detailed information about each operation, including its type (e.g., payment, create_account, account_merge, trade), sender and recipient identifiers, asset type (native XLM or user-issued tokens), amount, and timestamp. For enhanced data control, an additional field, details, was included to store diagnostic information. The compiled CSV file served as the basis for subsequent analyses.

The second stage of the research was conducted in the Python environment. The following libraries were used:

- pandas and numpy – for loading files, cleaning data, and creating event data frames,
- matplotlib – for creating visualizations and histograms,
- networkx – for constructing and analyzing the transaction graph, including the computation of centrality measures.

The empirical investigation proceeded in multiple stages. The first step involved isolating actual value transfers, i.e., payment operations. Subsequently, the assets transferred through payment operations were examined to assess the diversity of asset flows in the ledger. The next stage consisted of analyzing ledger activity over time. For each ledger, the total number of operations and the aggregate amount transferred through payment operations were calculated. These time series enabled the evaluation of network activity variability and the identification of periods of increased load.

The following stage focused on asset structure analysis. A ranking of the most frequently used tokens was created, based on both the number of payment operations and the aggregate amount transferred. The distribution of individual payment amounts was also examined through histograms, allowing for the identification of both small-value payments and rare, large-scale transfers. A particularly important part of the empirical investigation was the assessment of activity concentration among network participants. For each address, the total volume of received and sent payments was calculated. Based on these data, rankings of the top-N participants ($N = 1, 10$, and 1% of the population) were created, along with Lorenz curves. In addition, Gini coefficients were computed to provide a quantitative measure of inequality in activity distribution.

The final stage involved network analysis. Based on the transactional data, a directed graph of the Stellar network was constructed, where nodes represented blockchain addresses and edges represented payment flows between them, with transferred amounts used as edge weights. Using the `networkx` package, weighted flow measures were computed, including in-strength, out-strength, and total strength. These measures represent the sums of incoming, outgoing, and combined payment amounts, respectively, rather than the numbers of connections. This analysis enabled the detection of hub structures and the assessment of whether network activity is evenly distributed or dominated by a small group of entities.

All empirical outputs – from time series and histograms to rankings, Lorenz curves, and network indicators – were saved as CSV and PNG files. These outputs formed the basis for interpretation in the context of the existing literature and for drawing conclusions regarding the nature and potential of the Stellar network as a global payment infrastructure. The time-series assessment allows for assessing the network's stability and capacity to handle increasing load. The assessment of asset structure captures the diversity and practical scope of the platform's applications. The concentration measures, supported by Gini coefficients, reveals the extent to which network activity is dispersed or dominated by a few participants. Finally, graph-theoretic and centrality measures identify the key nodes that may serve as institutional payment hubs. The combined application of these methods provides a comprehensive view of Stellar's operation – both from technical and economic perspectives – and enables an assessment of its suitability as a potential infrastructure for cross-border payments.

Literature Review

Blockchain technology has attracted wide attention as a potential alternative to traditional payment systems, offering greater transparency, lower costs, and shorter settlement times (Lokhava et al., 2019). Stellar, as one of the leading platforms of this type, introduced a unique consensus mechanism – the Stellar Consensus Protocol (SCP) – whose correctness has been formally proven (García-Pérez & Schett, 2020). The literature emphasizes that, unlike classical PBFT models or

Proof-of-Work mechanisms, SCP enables open membership and high energy efficiency, which is of particular importance in financial applications. At the same time, researchers note that blockchain technology is not free from risks, and that certain consensus mechanisms may be vulnerable to specific attacks and do not always guarantee a higher level of security compared to traditional centralized systems (Baranowski & Korczak, 2022). Furthermore, Dasgupta et al. (2019) highlight that the development of blockchain still faces significant security challenges, including cryptographic vulnerabilities as well as network- and application-layer attacks. The authors identify eight major categories of threats, including Sybil and Eclipse attacks, timing manipulation, vulnerabilities in smart contracts, and risks related to quantum computing, emphasizing that these technologies require further advancement before they can serve as fully secure financial infrastructures.

From an economic perspective, Stellar is viewed as a platform supporting tokenization and decentralized payment solutions. Research points to its growing role in the banking sector, where it is used for token issuance and asset distribution through collective mechanisms (Shamsi et al., 2022). Howell et al. (2023) draw attention to the degree of node decentralization in the Stellar network compared with other platforms, noting the limited hosting-provider diversity and the dominance of large cloud service providers. This analysis shows that, despite the open nature of the SCP protocol, the practical decentralization of the network is significantly constrained by the concentration of technical infrastructure. The present study complements this approach by analyzing transactional flows between wallets, offering a different perspective on decentralization – not in terms of node distribution and ownership, but by evaluating the distribution of activity and value transfers among network participants. The comparison of both perspectives indicates that, at both the infrastructural and financial-flow levels, the Stellar network exhibits a high degree of concentration, raising questions about the actual level of decentralization of the platform.

The issue of decentralization and activity concentration in blockchain networks has been the subject of numerous quantitative studies. The literature increasingly applies inequality measures – including the Gini coefficient – to assess the degree of value-flow centralization. The possibility that the top 1% of addresses may control between 70% and over 90% of a measured network resource illustrates why comparisons must clearly distinguish among token holdings, consensus power, and transaction volume. Jia et al. (2022) demonstrated that governance-token balance distributions differ substantially across emerging public blockchains, while Juodis et al. (2024) documented pronounced differences in wealth concentration between the examined Layer 1 and Layer 2 networks. It is worth noting that the discussion on the balance between decentralization and efficiency is crucial not only from the perspective of distributed systems theory but also in the practical context of applying blockchain technology to international payments. Like other next-generation platforms, Stellar faces the challenge of reconciling high scalability and settlement speed with maintaining an adequate degree of power distribution within the network.

Research Results

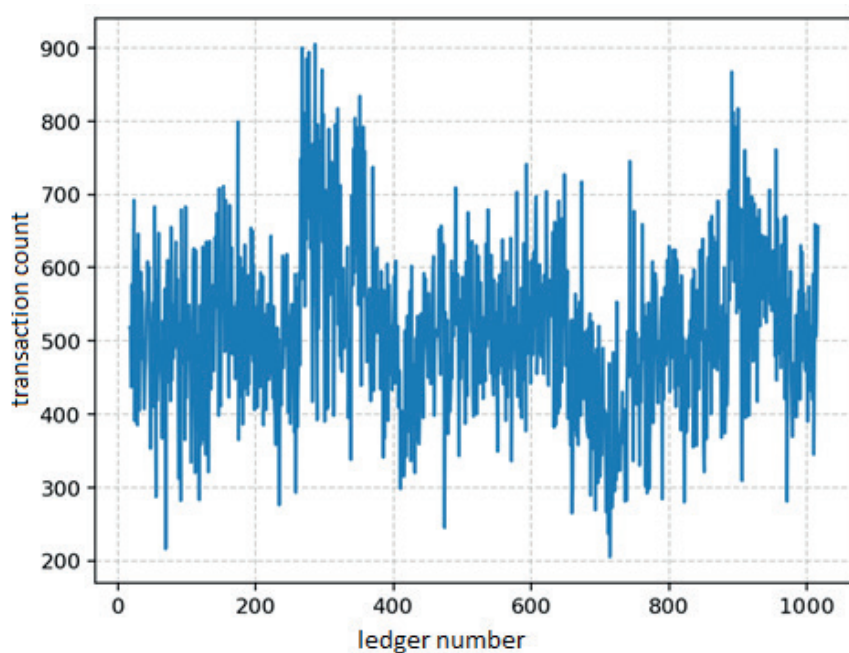
The aim of the empirical analysis was to capture the characteristics of the Stellar network based on data from a sample of 1,000 consecutive ledgers. Quantitative examination of the collected dataset produced findings in three areas: the dynamics of operations, the structure of assets, and the concentration of participants along with the overall network structure.

Transaction Dynamics

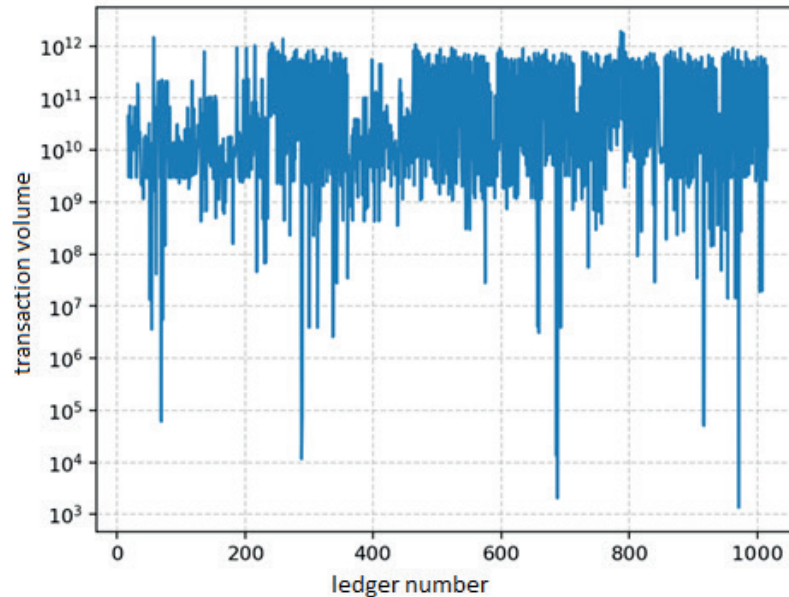
In the analyzed sample, a high variability in the number of operations per ledger is observed, with typical values ranging between 400 and 700 operations (Figure 1). The recorded peaks indicate periods of increased activity, which may be associated with token issuance or exchange events. Even greater variability is evident in aggregate amounts transferred through payment operations, which display a wide range and the presence of outlier payment operations (Figure 2). The observed pattern confirms that the Stellar network is capable of handling both small-scale payments and large-value payment operations.

Figure 1

Number of Operations per Ledger



Source: author's own visualization based on Stellar blockchain ledger data, prepared with the matplotlib library in Python.

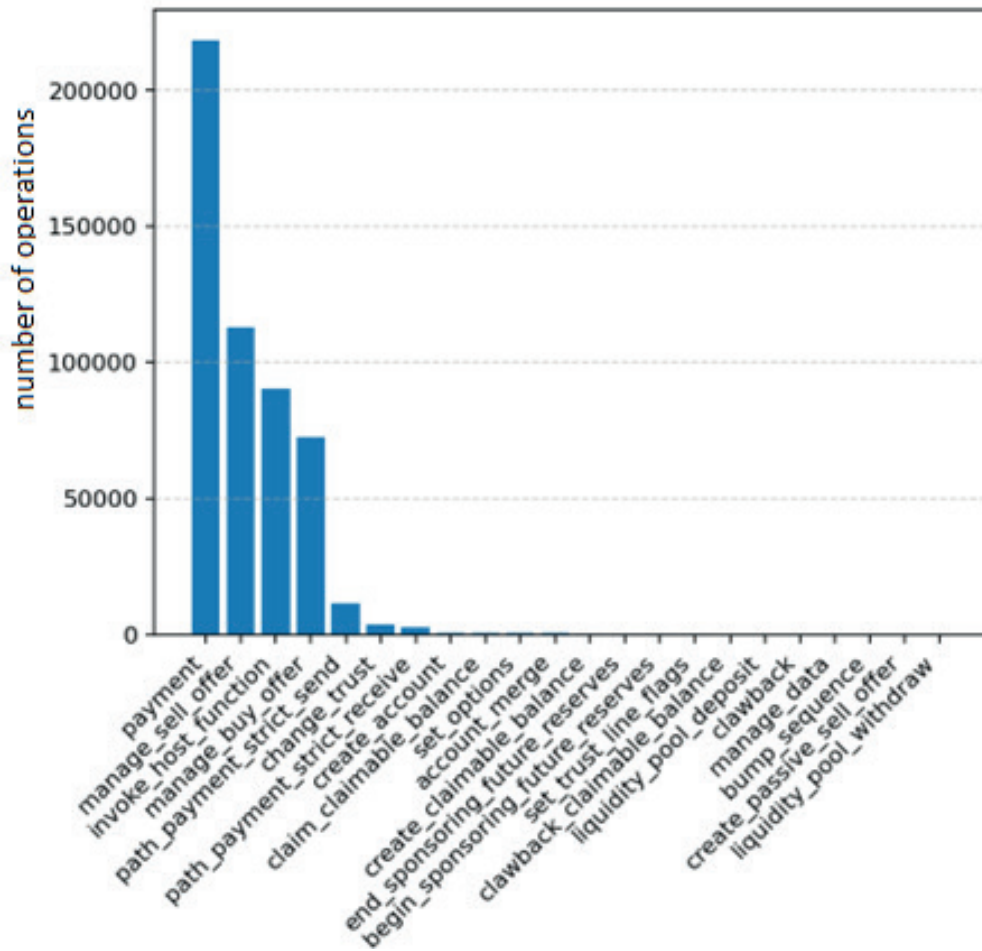
Figure 2*Payment Volume per Ledger – All Assets*

Source: author's own visualization based on Stellar blockchain ledger data, prepared with the matplotlib library in Python.

Examination of outlier values showed that the top 1% of the largest payment operations accounted for a substantial portion of the total volume. The largest individual payment operations exceeded 9.1×10^{11} units in assets such as XRP, XLM, and USDC. Among the high-value transfers, several payment operations were also recorded in less common tokens, including GERMANIUM (8.99×10^{11}) and CHROMIUM (8.84×10^{11}). These findings confirm the highly skewed nature of the distribution – the network processes both numerous small payment operations and a small number of large-scale transfers.

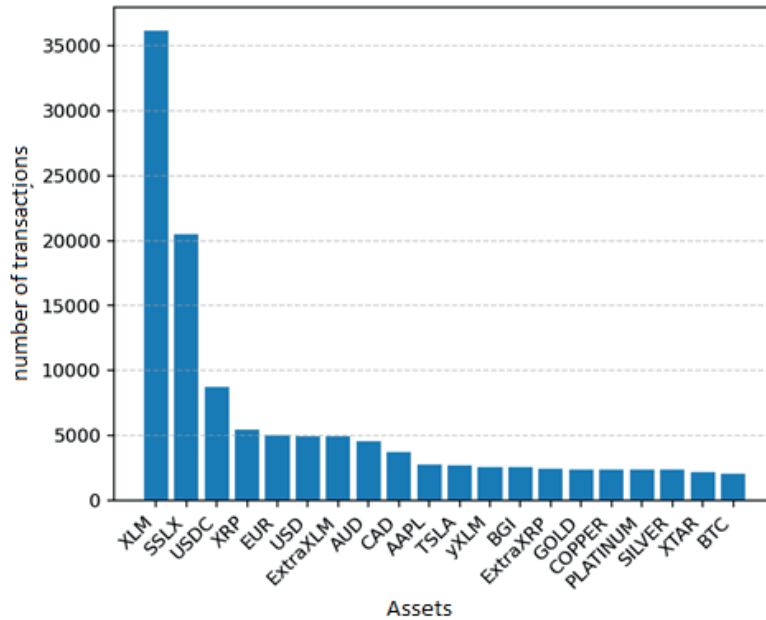
Asset Structure

The distribution of operation types confirmed the dominant role of value transfers (payments), which accounted for the vast majority of operations in the examined sample (Figure 3). In terms of the number of payment operations, the highest shares were recorded for XLM, SSLX, and USDC, while among the tokens, XRP and those linked to fiat currencies (EUR, USD, CAD) and financial instruments (e.g., AAPL, TSLA) also played a significant role (Figure 4).

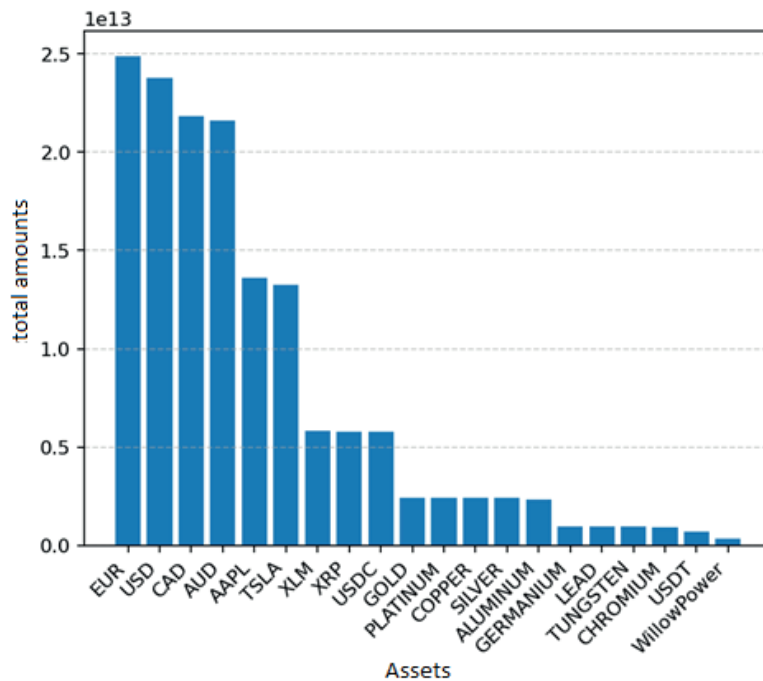
Figure 3*Share of Operation Types – by Count*

Source: author's own visualization based on Stellar blockchain ledger data, prepared with the matplotlib library in Python.

In turn, the volume-based analysis shows that the most significant assets include tokens linked to traditional currencies and commodities, rather than solely the native XLM token. The largest payment flows were recorded in tokens such as EUR and USD (traditional currencies), as well as CAD and AUD, all of which substantially exceeded XLM's share in quantitative terms (Figure 5).

Figure 4*Top Assets by Number of Payment Transactions (Top 20)*

Source: author's own visualization based on Stellar blockchain ledger data, prepared with the matplotlib library in Python.

Figure 5*Top Assets by Payment Volume (Top 20)*

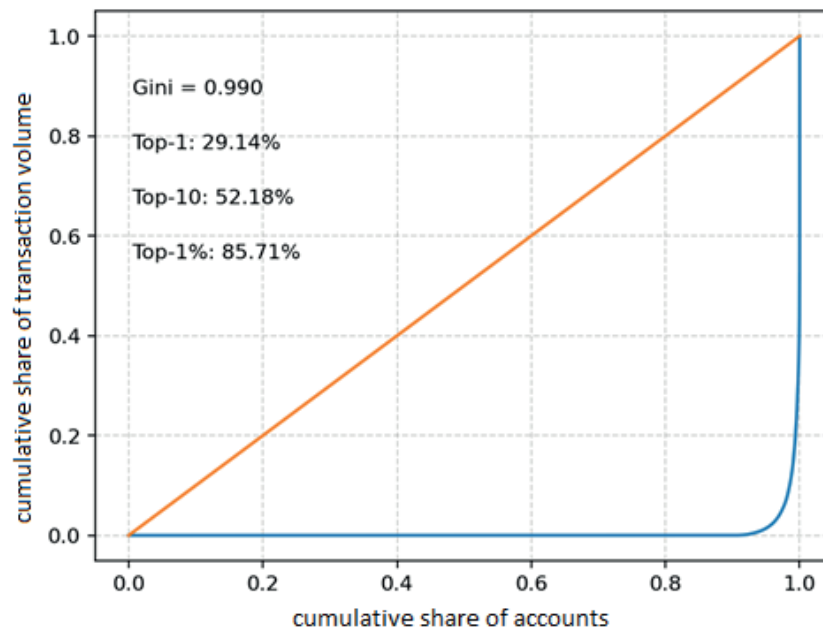
Source: author's own visualization based on Stellar blockchain ledger data, prepared with the matplotlib library in Python.

Participant Concentration and Network Analysis

The next stage involved assessing the concentration of participant activity. The application of the Lorenz curve and the Gini coefficient clearly demonstrated that transaction activity within the Stellar network is highly concentrated. The Gini coefficient reached a value of 0.99, indicating an extremely unequal distribution of activity. The largest single account in the analyzed sample accounted for 29.14% of the total transaction volume, while the ten largest participants were responsible for more than half of the volume, and the top 1% of accounts accounted for nearly 86% of the total transaction volume (Figure 6).

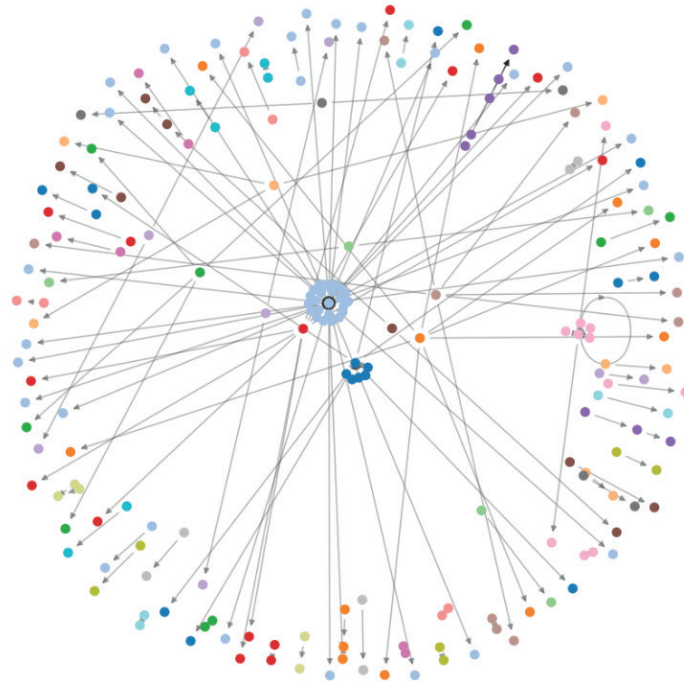
Figure 6

Lorenz Curve – Total Volume per Account



Source: author's own visualization based on Stellar blockchain ledger data, prepared with the matplotlib library in Python.

The constructed transaction graph (Figure 7) reveals a core–periphery structure typical of blockchain networks, dominated by a few central nodes with high centrality and a large number of connections. This indicates that, despite the network's open nature, the liquidity and overall functioning of Stellar largely depend on the activity of a narrow group of entities.

Figure 7*Communities in the Stellar Network (Graph Analysis)*

Source: author's own visualization based on Stellar blockchain ledger data, prepared with the matplotlib library in Python.

The community detection algorithm confirmed the presence of several distinct groups of nodes. Most of the activity was concentrated within the largest community, dominated by key nodes. The topology of the transaction graph indicates a highly concentrated structure. The largest nodes exhibited very high total-strength values (the combined amounts of inbound and outbound payment flows) (Table 1). Due to the lack of publicly available metadata (e.g., home_domain), it was not possible to unambiguously identify the owners of these accounts. In particular, the two top-ranked addresses displayed nearly zero in-strength and very high out-strength values, suggesting that they may have functioned as distribution hubs, forwarding funds to other network participants. Such activity patterns may indicate accounts belonging to exchanges, financial institutions, or specialized service providers operating within the Stellar network.

Table 1*The Most Significant Nodes in the Stellar Network by Incoming and Outgoing Payment Amounts*

Account address (shortened)	Incoming amount (in-strength)	Outgoing amount (out-strength)	Total amount (total strength)
GAVU7F5JQ...OTBPB...	~ 0	9.18×10^{13}	9.18×10^{13}
GC4KZI5J...LBJNDT...	~ 0	2.69×10^{13}	2.69×10^{13}
GBLPLCH4Z...MJXJJ...	4.69×10^{12}	4.72×10^{12}	9.41×10^{12}
GBGVP5AJS...FIIL...	4.36×10^{12}	4.46×10^{12}	8.82×10^{12}
GBWWDaubX...NLJS...	3.53×10^{12}	4.46×10^{12}	7.99×10^{12}

Source: author's own elaboration based on data from the Stellar blockchain ledger.

These values are incomparably higher than the median of the distribution, which amounted to only 0.01, demonstrating that flows within the network are heavily dominated by a small number of entities. Additionally, the in-strength and out-strength values of the five most significant nodes were compared. The comparison indicates that the dominant accounts conducted almost exclusively outgoing payment flows. For instance, the address GAVU7F5JQ...OTBPB... had an out-strength of 9.18×10^{13} with a nearly zero in-strength. A similar pattern was observed for the address GC4KZI5J...LBJNDT... (out-strength 2.69×10^{13} , in-strength 0). More balanced activity was observed for other nodes, such as GBLPLCH4Z...MJXJJ..., for which inbound and outbound values were approximately equal ($\approx 4.7 \times 10^{12}$). This evidence suggests the existence of both “sending hubs” and nodes that participate more symmetrically in the transfer of funds in both directions.

Discussion of Results

The obtained evidence indicates a high level of activity concentration, with a small number of nodes functioning as transactional hubs. The Gini coefficient for transaction volume in the analyzed sample reached 0.99, while the top 1% of accounts accounted for nearly 86% of the total volume. Such a high degree of inequality is comparable to values reported in studies of other blockchain networks. Although their analysis concerns wealth distribution rather than transaction volume, Juodis et al. (2024) reported Gini coefficients of 0.6538 for Bitcoin and 0.8298 and 0.8457 for Ethereum before and after its transition from Proof-of-Work to Proof-of-Stake, respectively. Values above 0.95 were observed for the examined Layer 2 networks. Jia et al. (2022) likewise identified substantial inequality in governance-token distributions across

selected emerging public blockchains, although their analysis concerns token holdings rather than transaction volume.

Comparable observations also concern the role of central nodes. In the Stellar study, the three largest accounts exhibited total-strength values on the order of 10^{13} – 10^{14} , whereas the median of the distribution was only 0.01. This discrepancy confirms the existence of a centralized structure in which a few nodes dominate the remaining participants. A similar phenomenon was described by Sultanik et al. (2022), who found that in Bitcoin and Ethereum, a small number of mining pools and infrastructure providers control the majority of network power, rendering decentralization largely superficial. In comparison with previous studies, the methodological approach is also noteworthy. Tasca (2015) analyzed Bitcoin transfer data in an aggregated form, whereas Juodis et al. (2024) used the Herfindahl–Hirschman Index and complementary inequality measures to assess wealth concentration, finding markedly greater concentration in the examined Layer 2 networks than in Bitcoin and Ethereum. In the present Stellar analysis, direct data from 1,000 consecutive ledgers were used, allowing for an assessment of both payment-volume dynamics and asset structure. This approach aligns with contemporary on-chain analyses such as those by Schmid and Shestakov (2024), who demonstrated, using data from the Gitcoin and Internet Computer projects, that despite formal mechanisms of democratization, actual decision-making power tends to be concentrated within a small group of entities.

It is worth emphasizing that concentration in blockchain networks is not limited solely to transactional flows. Petryk and Li (2025) showed that similar phenomena occur within developer and community structures, where a small group of programmers is responsible for key decisions regarding protocol development. The Stellar findings thus contribute to the broader discussion on the limitations of decentralization – even in systems designed to be open, market, technological, and organizational mechanisms often lead to concentration of both activity and power.

From a financial-market perspective, the findings indicate that Stellar combines functions relevant to cross-border settlement with substantial concentration in the accounts that channel value. The observed use of fiat-linked tokens and high-value transfers supports its potential role in payment and tokenization services, consistent with the applications discussed by Lokhava et al. (2019) and Shamsi et al. (2022). However, the present sample does not establish comparative transaction costs, service quality, or long-term capacity; it therefore supports an assessment of structural potential rather than a claim of superiority over established payment infrastructures.

For banks and payment service providers, the concentration measures have a direct operational interpretation. If the unidentified hub-like accounts perform exchange, custody, or settlement functions, their dominance may improve routing efficiency while also creating dependence on a small set of intermediaries. Disruption, withdrawal, or illiquidity at such nodes could therefore affect the continuity and distribution of payment flows. This inference is consis-

tent with the broader concern that formal openness can coexist with concentrated infrastructure, as reported for Stellar by Howell et al. (2023), but the anonymous ledger data do not permit attribution of the observed accounts to particular institutions.

The findings also matter for financial supervision. Address-level transparency does not by itself provide institutional transparency: the ledger shows the size and direction of flows, whereas the identity, legal status, contractual obligations, and risk-management arrangements of the dominant operators remain unknown. For the financial sector, this distinction limits counterparty assessment and complicates the evaluation of concentration and operational risk. Accordingly, any institutional use of Stellar as payment infrastructure would require governance and monitoring arrangements that connect on-chain activity with identifiable service providers; the current dataset can identify where concentration occurs, but not whether those arrangements are in place.

Research Limitations

At the same time, the empirical design is subject to several important limitations. First, due to the anonymous nature of the Stellar network, it is not possible to unambiguously assign accounts to specific financial institutions or business entities. Identification would be feasible only if an account operator publicly disclosed metadata (e.g., through the `home_domain` parameter in the `stellar.toml` file). In the analyzed sample, none of the five largest nodes contained such information; therefore, the interpretation was limited to a functional characterization (e.g., as sending hubs or intermediary nodes) without specifying ownership. Second, the sample covered only 1,000 consecutive ledgers, which allows for an analysis of short-term network properties but does not fully reflect long-term trends or structural changes. For this reason, future research should include longer observation periods and combine ledger data with information from exchanges and payment operators. Such an approach would enable a more comprehensive characterization of the roles of individual participants and a clearer understanding of their significance within the global payment infrastructure based on Stellar technology.

Conclusions

The empirical investigation captured the fundamental characteristics of the Stellar network's operation in the short term. Transaction-dynamics measures revealed clear fluctuations in the number of operations and aggregate payment amounts across consecutive ledgers, indicating varying intensity of network usage over short time intervals. The examination of asset structure showed that, in addition to the native XLM token, tokens linked to fiat currencies and other financial instruments also play a significant role, reflecting the wide and diversified range of the network's applications. Another important finding was the identification of outlier values.

Rare but extremely large payment operations, which confirmed the strongly skewed nature of the flow distribution. A particularly noteworthy result is the high level of participant activity concentration, as measured by the share of the largest accounts in total volume, the Gini coefficient values, and the shape of the Lorenz curves. Finally, the graph-based analysis confirmed the presence of hub-like nodes that dominate the network in terms of aggregate incoming and outgoing payment amounts. These nodes, acting as senders or intermediaries, play a crucial role in fund transfers, indicating that Stellar's actual decentralization is limited in practice.

From a financial-sector perspective, Stellar can function as a programmable payment, exchange, and settlement layer rather than merely as a market for XLM. The network combines open membership with issuer-specific assets, a built-in decentralized exchange, path payments, and atomic transfers involving assets issued by different entities. Anchors connect this shared ledger with domestic payment rails by providing fiat on- and off-ramps, while a path payment can convert the sender's token into the recipient's token within one operation. For banks and payment service providers, this model offers a possible alternative to multi-hop correspondent chains and may support faster routing, greater competition, and more continuous cross-border service. It can therefore affect financial market infrastructure by relocating part of the exchange and settlement process from bilateral institutional chains to a common network. However, the present dataset does not compare end-to-end costs, service quality, or long-term capacity with established systems; the conclusion is consequently limited to technological and structural potential (Lokhava et al., 2019; Zhuo et al., 2023).

The application of Stellar in the financial sector can involve a division of responsibilities among several regulated actors. Banks, regulated financial institutions, money service businesses, and FinTech companies act as anchors or token issuers; other institutions may provide custody, wallets, liquidity, validation, or bridge and compliance services. Stellar's trustline model permits an issuer to authorize which accounts may hold its asset. In the anchor model, the issuer also has to organize reserve custody, redemption, auditing, and compliance with applicable AML/KYC requirements. Bridge and compliance servers can connect ledger operations with existing account systems and enable institutions to exchange information about senders and beneficiaries before approving a transfer. These functions show that cooperation with banks is not incidental to institutional adoption: it is central to converting on-chain tokens into enforceable claims on off-chain value (Lokhava et al., 2019; Zhuo et al., 2023).

Asset tokenization extends this institutional model beyond fiat-linked payment tokens. Documented uses of the Stellar ledger include assets linked to currencies, real estate, commercial bonds, carbon credits, and other application-specific rights. Research on an open-source voting application further demonstrates that Stellar tokens can encode non-monetary claims and can be used as auditable, transferable records, although the same study identifies limitations

in smart-contract functionality and network throughput. At the application layer, a separate payment-portal prototype shows how wallets, a Stellar software development kit, and Horizon services can be combined to initiate and confirm token transfers. For financial institutions, these examples suggest opportunities to develop currency-backed payment tokens, securities or other asset representations, but each instrument still requires an identifiable issuer, clearly defined holder rights, secure custody, reliable redemption or transfer arrangements, and an appropriate legal classification (Lokhava et al., 2019; Barański et al., 2020; Khilji, 2023).

A major practical opportunity offered by Stellar is to combine cross-border payments with financial inclusion. Case studies of African Stellar-based projects indicate that local-currency stablecoins, integration with familiar channels, cash-in and cash-out access, and partnerships with local payment and identity providers can make services more accessible to unbanked and underbanked users. They also show why banks and existing payment institutions need not be wholly displaced: their domestic rails, compliance capacity, customer access, and liquidity can complement the common ledger. The benefits are context-dependent, however. Adoption depends on financial and digital literacy, reliable identity arrangements, user-friendly interfaces, local-currency liquidity, and cooperation among governments, financial institutions, technology firms, educational institutions, and civil-society organizations. The examined projects remain at an early stage, so their potential for inclusion should not be interpreted as evidence of universal or large-scale effectiveness (Zhuo et al., 2023).

These opportunities are accompanied by risks that are material to banks, supervisors, and financial market regulators. The concentration observed in the present study means that routing efficiency may coexist with dependence on a limited number of hubs. Earlier Stellar research also shows that validator misconfiguration and dependence on systemically important operators can impair network liveness and may require manual coordination during disruption. Fiat-linked tokens introduce additional reserve, redemption, custody, liquidity, cyber-security, operational, and market-integrity risks. At sufficient scale, weak backing or a loss of confidence could create redemption pressure, while dominant stablecoins could affect competition, capital flows, and the monetary autonomy of weaker-currency jurisdictions. Institutional use should therefore be supported by identifiable operators, reserve verification, redemption planning, segregation of client assets, operational redundancy, incident management, and continuous monitoring of both transaction and validator concentration (Lokhava et al., 2019; Zhuo et al., 2023).

In the European Union, these institutional roles need to be assessed under the Markets in Crypto-assets Regulation (MiCA). Classification depends on the economic characteristics of a Stellar-based token rather than on the network on which it is issued. A token referring to one official currency may qualify as an e-money token, whereas a token stabilized by reference to other assets or a combination of values may fall within the asset-referenced-token regime.

Crypto-assets qualifying as financial instruments are excluded from MiCA and remain subject to the existing financial-services framework. The professional provision of crypto-asset services generally requires authorization or eligible financial-entity status; certain financial entities, including credit institutions, may provide specified services after the required notification. MiCA further imposes requirements relating to prudential safeguards, governance, custody and segregation of client assets, and issuance and redemption. Cooperation between Stellar-based providers and banks must therefore be organized around a case-specific determination of the token, issuer, service, custody model, and competent supervisory authority (Regulation (EU) 2023/1114, Arts. 2–3, 48–49, 59–60, 67–68 and 75).

MiCA narrows several legal gaps but does not eliminate the boundary and supervisory problems revealed by the empirical analysis. Public addresses do not by themselves identify the institution performing an issuer, exchange, custody, or settlement function. Moreover, MiCA distinguishes services attributable to identifiable intermediaries from services provided in a fully decentralized manner without an intermediary, and it requires further assessment of the regulatory treatment of decentralized finance. Cross-border stablecoin arrangements also operate across jurisdictions whose classifications, reserve standards, and enforcement capacity may differ (Zhuo et al., 2023). Effective supervision therefore depends on linking on-chain activity to legally accountable entities, coordinating oversight across borders, monitoring concentration and transaction flows, verifying reserve and redemption arrangements, and assessing operational resilience and outsourcing dependencies. These measures become particularly important when the scale of a token or the concentration of gateways could affect client protection, market integrity, the continuity of payment services, or financial stability. Overall, Stellar offers a technically credible platform for financial innovation, but its institutional value depends on governance, liquidity, legal accountability, and regulatory compliance developing alongside network adoption (Regulation (EU) 2023/1114, recitals 8, 22 and 73; Arts. 46–49 and 141–142).

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