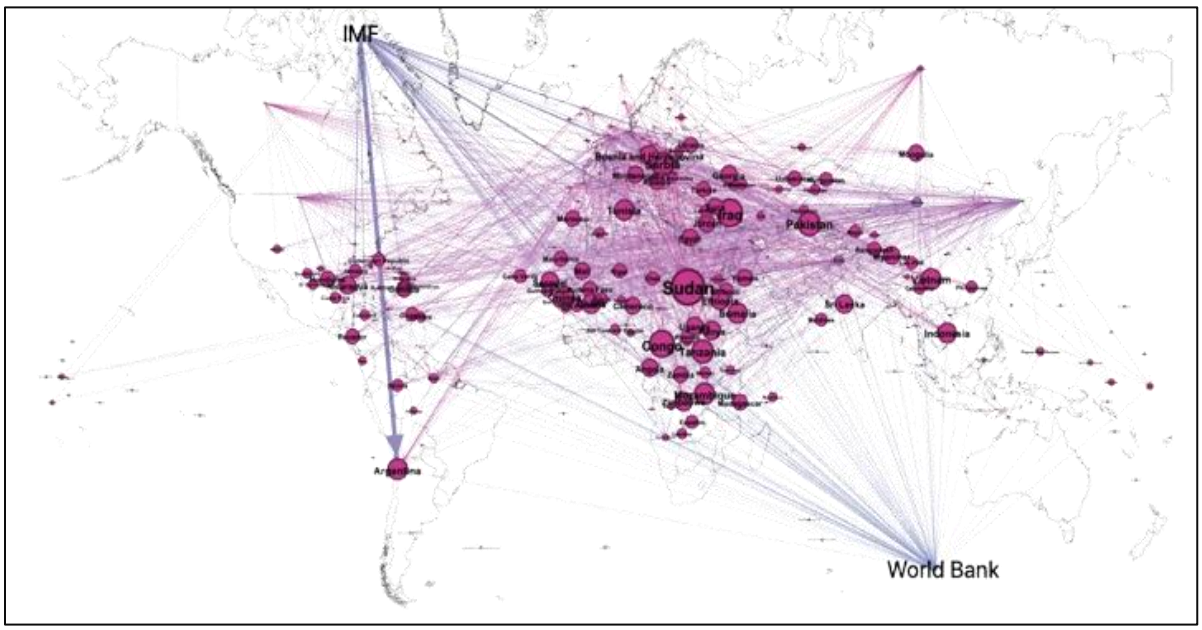

Global Lending Network mapping financial relationships between the IMF, the World Bank and various nations. **Authors:** Abdul Qadir, Baloch, and Qasmi.

Mapping Global Lending Networks

A SOCIAL NETWORK ANALYSIS OF LOAN RELATIONSHIPS BETWEEN COUNTRIES AND FINANCIAL INSTITUTIONS

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Abstract

This study analyzes the global lender-borrower network to uncover behavioral patterns of international financial loan flows. Focusing on major entities like the IMF, World Bank, and bilateral lenders, the research explores disparities between the Global North and Global South, highlighting key factors such as betweenness centrality, clustering coefficients, and eigenvector centrality. Using data on loans from multiple sources extracted and processed using R and Python, the study applies network analysis techniques to identify influential nodes, dense clusters, and regional trends. Findings reveal that while institutions like the IMF and World Bank dominate lending, they operate as independent hubs rather than intermediaries. Countries in the Global North exhibit financial stability with minimal borrowing, while the Global South demonstrates diverse borrowing behaviors, often shaped by geopolitical and economic alliances. Visualizations of network metrics done using Gephi provide insights into the interconnected yet uneven nature of global financial relationships.

Keywords

Lender borrower, betweenness centrality, clustering coefficients, borrowing behaviors, connections, global financial landscape.

Introduction

The global financial landscape is characterized by complex lending and borrowing relationships that play a critical role in shaping economies worldwide. This study focuses on the lending and borrowing dynamics within the financial sector, specifically examining key entities like the International Monetary Fund (IMF), the World Bank, and individual countries that act as lenders. It maps these entities against nations that borrow from them, providing a network analysis of these interdependencies.

The study investigates disparities and trends in global borrowing, focusing on how financial flows differ between regions, particularly the Global North and Global South. It also explores the strategic considerations behind lending and borrowing decisions. Another critical issue is understanding the structure of these financial networks, including the presence of distinct groups or communities of borrowers and lenders and the insights these clusters provide about regional or economic alliances.

The primary objectives of this study are:

- To identify discernible patterns in the borrowing behaviors of Global North and Global South countries.
- To determine which regions borrow the most and from which lending entities.
- To detect clusters or communities within the loan network and analyze their implications.

The report begins with a review of related literature to establish the context and significance of lending and borrowing patterns. This is followed by a section on data collection and preparation. Next, the methodology employed for network analysis is described in detail. Finally, the findings are presented and discussed, offering insights into the behavioral patterns and structural dynamics of the financial lending network.

Literature Review

International lending practices are influenced by factors such as geopolitical interests and relational dynamics between nations and institutions. While organizations like the World Bank and IMF play key roles in financial assistance, critiques point to accountability gaps. Nordquist and Kitz (2024) argue that the IMF often prioritizes strategic interests over fiscal responsibility, exemplified by Argentina's repeated failure to meet loan obligations without consequences. This raises concerns about whether lending practices genuinely support development or serve geopolitical objectives.

Trust and social capital also significantly influence lending behavior. Cassar and Wydick's (2010) study found that high-trust groups were more likely to access additional loans, highlighting how social dynamics impact financial sustainability. Similarly, trust and relationships between nations may shape borrowing and repayment behaviors on an international scale.

China's Belt and Road Initiative (BRI) emphasize on these dynamics, raising concerns about "debt trap diplomacy." Rajah et al. (2019) highlight cases like Sri Lanka leasing 70% of Hambantota Port to China for 99 years after failing to repay loans (Moramudali, 2020). Such examples reflect dependency theory, where weaker nations rely on stronger ones, leading to imbalanced power dynamics (Kehinde-Balogun, 2023). China's opaque, less concessional loans have also heightened debt sustainability risks in smaller Pacific nations like Tonga and Vanuatu, contrasting with Australia's AIFFP, which emphasizes transparency and debt avoidance.

Shifts in policy further illustrate evolving priorities in international lending. Gallagher (2011) notes the IMF's transition from advocating capital flow liberalization to recognizing the benefits of capital controls, particularly for developing nations, reflecting growing resistance to policies that compromise financial sovereignty.

Network-based analyses provide additional insights. Bunte and Kinne (2018) show that countries with strong lending ties disproportionately benefit, revealing a network bias where allied nations reinforce each other's influence. Similarly, Godlewski and Sanditov (2024) demonstrate that central financial institutions in syndicated lending networks wield significant power in renegotiations, underscoring the role of network centrality.

Despite these insights, gaps remain. Current research often overlooks the broader global loan network, failing to analyze patterns across country-to-country lending and major entities like the IMF and World Bank. Moreover, the distinct lending and borrowing behaviors of Global North versus Global South countries remain underexplored. Our research aims to address these gaps by analyzing international lending and borrowing practices, with a particular focus on how factors like geolocation influence patterns within the global lending and borrowing network.

Data and Network Construction

The dataset was compiled from three sources: World Bank loans, IMF loans, and country-to-country bilateral loans. World Bank data, manually extracted into Excel, included IBRD loans (for reconstruction and development) and IDA loans (interest-free loans for the poorest countries), which were merged in Python to calculate total amounts. IMF loans, initially in Special Drawing Rights (SDRs), were also copied into Excel. Country-to-country loan data was extracted via API web scraping in R using the indicator DT.DOD.BLAT.CD (bilateral debt in current USD).

The preprocessing phase focused on cleaning, standardizing, and structuring the data to make it suitable for network analysis. First, the IMF loans (in SDRs) and World Bank loans (in USD millions) were converted into a standard USD format to ensure consistency across all datasets. Python was used to perform this currency conversion.

Next, country names across the datasets were checked and standardized to ensure uniformity. For example, discrepancies such as "Turkey" versus "Türkiye" were resolved by adopting a single naming convention. Non-country entries, such as regional aggregates like "South Asia," were removed to focus solely on individual countries. A manual cleaning process was carried out as a final step to match all the country names to a standardized list from the Kaggle dataset (Mooney, 2020). This is also where latitude and longitude values were extracted.

Nodes in this network represent countries and institutions (e.g., IMF, World Bank), with spatial attributes such as latitude and longitude included for visualization purposes. Edges are directed, where the source node represents the creditor, and the target node represents the debtor. The weight of each edge reflects the loan amount in USD. All centralities and clustering coefficients were computed using R.

Community detection identifies groups of nodes that share similar characteristics or relationships within a network. In this loan network, no distinct communities were detected, indicating that the financial connections are more globally dispersed rather than localized into specific groups.

The network was visualized using Gephi. The dataset, prepared as a CSV file, included the latitude and longitude of each country (sourced from a Kaggle dataset), allowing for spatially accurate plotting of nodes. The network used in the analysis included in-degree and out-degree of the nodes. The node sizes were scaled based on their degree, with larger nodes representing countries or institutions with higher degrees of financial activity. The edges were colored based on in and out degree with blue edges representing out degree and purple representing in degree of the node. Edges were also weighted, with thicker lines representing larger loan amounts.

Analysis and Discussion

1.On Centralities

The analysis of the loan network utilizes several key metrics to understand its structure and dynamics. Betweenness centrality measures how often a country (node) acts as a bridge between other nodes, indicating its role in facilitating financial interactions. Indegree represents the total number of incoming connections, showing how much a country owes to lenders, while outdegree reflects the number of outgoing connections, representing loans a country or institution has given. Finally, the clustering coefficient quantifies the tendency

of a node's neighbors to form closed triads, revealing localized group formations in the network.

Betweenness	**Out Degree**	**In Degree**	**Closeness**	**Local Clustering**
China	France	Sudan	China	Ireland
India	Kuwait	Iraq	France	Oman
Iraq	China	Congo	Kuwait	Belize
Serbia	Japan	Serbia	Japan	Kazakhstan
Angola	Germany	Pakistan	Germany	Equatorial Guinea

Table 1: Top 5 countries as per the centralities

In the network, countries with the highest betweenness centrality as shown in Figure 1 act as important bridges, connecting less-linked nations with global financial institutions and ensuring the flow of financial resources and information. If these high-betweenness countries are removed or their role is weakened—due to political instability, policy changes, or economic challenges—it could disrupt the financial system. This disruption may lead to delays in resource distribution, reduced efficiency in financial transactions, and weakened connections between other countries.

Countries with high closeness centrality as shown in Table 1 are often the most efficient in the network, as they have quick access to resources and information and can disseminate these effectively. Their strategic position also gives them significant influence, allowing them to play an active role in shaping network interactions.

This creates a hierarchy within the network, where countries with high closeness and betweenness centrality hold significant soft power. These countries act as intermediaries, connecting less-connected nations with global financial institutions and influencing negotiations and resource distribution. Their position often gives them priority in decision-making, allowing them to shape policies that align with their interests. For instance, the IMF, with its central role in the network, uses its power by providing loans to countries like Pakistan but often imposes strict conditions (Masood, 2024). These conditions reflect the IMF’s influence in shaping the economic policies of borrowing nations, further consolidating its power in the global financial system.

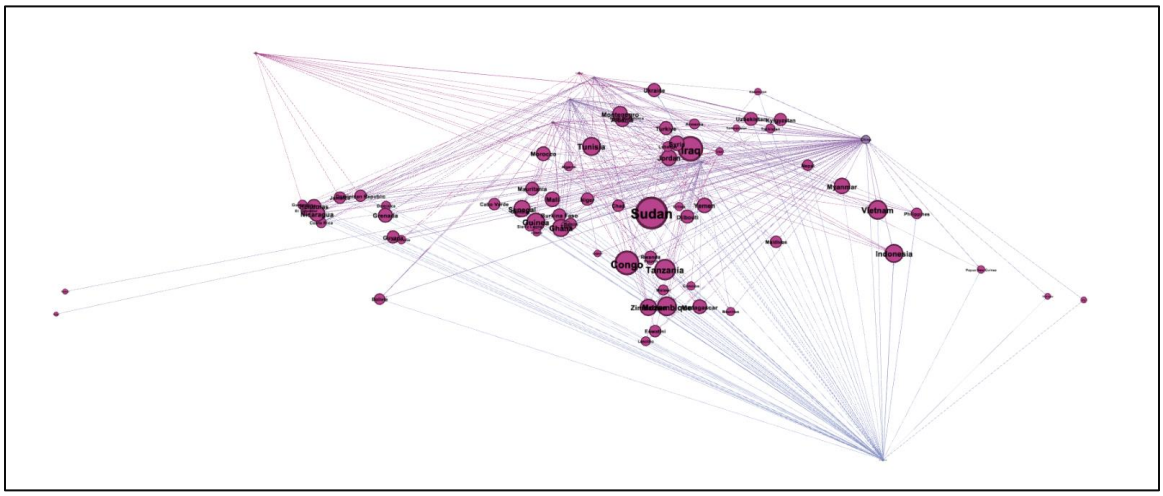

Figure 1: Ego Network of China

As evident in Figure 1, China's high out-degree reflects its position as a major lender, particularly in the Global South, while its high betweenness and closeness centrality highlight its strategic role in connecting different parts of the network and its ability to quickly access and distribute financial resources. These factors demonstrate China's strong influence and efficiency within the global financial system.

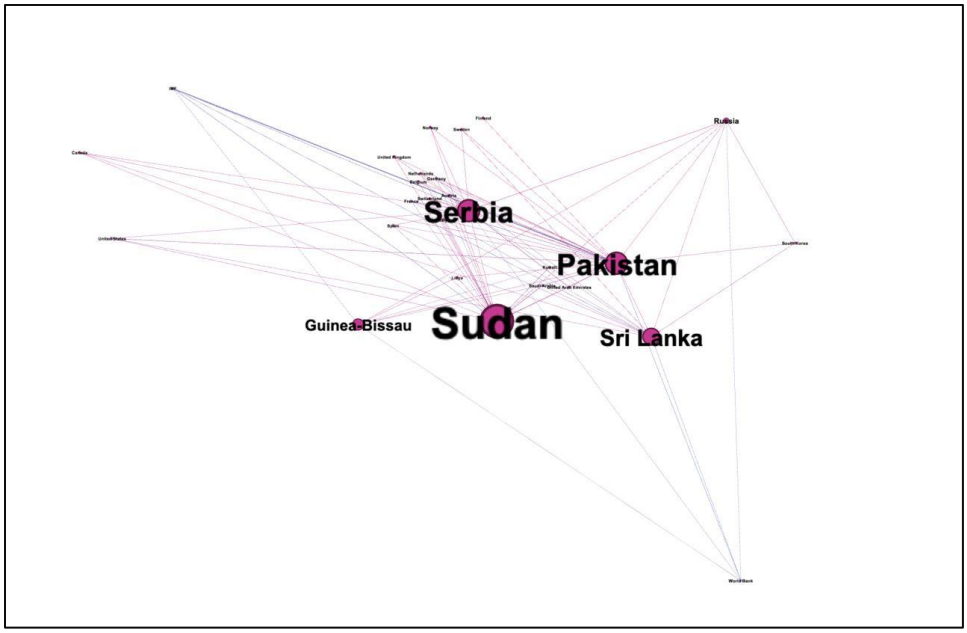

Figure 2: Ego Network of Pakistan

On the other hand, as shown in the Figure 2, Pakistan's position in the same network shows a clear contrast. With a high in-degree and low out-degree, Pakistan depends heavily on borrowing to meet its financial needs. Its low betweenness and closeness centrality indicate its peripheral status, limiting its ability to influence global financial flows. The visual comparison of their ego networks (Figure 1 and Figure 2) further highlights this

difference—China's dense and interconnected network reflects its powerful and central role as evident in Figure 2, while Pakistan's sparse connections show its reliance on external support and its limited influence in the financial landscape.

2.On Network Models

Our network initially contained isolated nodes, representing entities that neither took nor gave loans, rendering them disconnected from the rest of the network. To focus on the primary structure, we filtered out these isolated nodes and analyzed only the connected components. After this adjustment, the network consisted of 191 nodes.

Comparison with Seminal Network Models:

Metrics	Largest Connected Component (LCC)	Erdos-Renyi (ER) Model	Barabasi-Albert (BA) Model	Watts-Strogatz (WS) Model
Nodes	191	191	191	191
Edges	1463	1473	1288	1337
Mean Distance	1.97	2.18	2.27	2.76
Transivity	0.107	0.082	0.131	0.526
Average Degree	15.32	15.42	13.49	14

Table 2: Network metrics of seminal network models

Our uni-partite network, consisting of 191 nodes and 1463 edges, demonstrates distinct structural characteristics when compared to seminal network models such as Erdős-Rényi (ER), Barabási-Albert (BA), and Watts-Strogatz (WS). The ER model, with its random edge distribution, closely mirrors our network in terms of average degree (15.42 vs. 15.32) and edge count.

However, its lower transitivity (0.082 vs. 0.107) and higher mean distance (2.18 vs. 1.97) suggest that the ER model lacks the clustering and compact connectivity observed in our network. The BA model, on the other hand, introduces a scale-free structure with a significantly lower average degree (13.49) and higher transitivity (0.131), indicating a hierarchical pattern with preferential attachment. This contrasts with our network's more uniform connectivity. The WS model, characterized by its high transitivity (0.526) and long mean distance (2.76), diverges from our network by emphasizing localized clustering at the expense of global compactness. Overall, while no single model fully replicates the structure of our network, the ER model aligns more closely with its global properties, whereas the BA and WS models provide complementary insights into clustering and hierarchical tendencies.

Conclusion

All in all, this study highlights the complexities of the global lending and borrowing network, underscoring the financial interdependencies that shape economic relationships worldwide. Through network analysis, it becomes evident that institutions like the IMF and World Bank play pivotal roles as independent hubs, while nations like China and Kuwait serve as key intermediaries due to their dual roles as lenders and borrowers. The findings reveal stark disparities between the Global North and Global South, with the former displaying financial independence and the latter often reliant on external loans. Regional lending patterns, such as Saudi Arabia's focus on South Asia, further emphasize the strategic and geopolitical considerations in financial networks. Ultimately, this analysis provides critical insights into the structure and dynamics of global lending practices.

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