Leveraging Network Science to Enhance Australia's Indo-Pacific Diplomacy

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Introduction

Despite having the 12th largest GDP globally and vast natural resources, Australia's isolated position and small population, among other factors, have meant that Australia has never been a great world power. As articulated in key foreign policy documents such as [1], Australia's recent approach to International Relations (IR) has focused on maximising regional influence while maintaining good relations with major powers and supporting multilateralism on the global stage – classic middle power diplomacy. However, a recent report by the Asia-Pacific Development, Diplomacy & Defence Dialogue (AP4D) in February 2024 found that Australia's regional standing is diminishing, and urged the country to strengthen its diplomatic efforts in the Indo-Pacific to prevent further decline in influence [2]. It is crucial for Australia to develop strategies to maximise its ability to assert itself in its region, especially given the intensifying US-China rivalry and China's growing assertiveness, backed by its significant economic resources.

This report seeks to solve the problem of Australia's declining regional influence by exploring how network science tools and methods can be applied to develop practical policy recommendations, focusing on network visualisation and description. These recommendations aim to enhance Australia's ability to project its power internationally by leveraging its position within global networks. Addressing this issue is important because enhancing Australia's influence in the Indo-Pacific is vital for its national security and economic prosperity in the face of growing regional competition.

Related work

A network science approach to IR focuses on the structural aspect of power, where structures are characteristics that emerge from ongoing patterns of relationships among agents (countries, organisations, people), which can define, enable, and restrict their actions [3]. While it is the association between nodes that is seen as most significant, recent work has emphasised that the characteristics of nodes, along with the topological network structure and edge weightings, should also be considered as they also impact the network structure [4]. This report will consider some node attributes as supplementary to the network structure.

Network Science has been increasingly applied to the field of IR. In [5], social network analysis was used to explore soft power networks formed through sports sponsorships. Several studies, such as [6], have explored the rise of "digital diplomacy" using social networks like Twitter and its use in expanding traditional diplomatic efforts. Such research demonstrates how countries can enhance their global standing through non-traditional forms of diplomacy and soft power networks.

The Diplomatic Impact Framework developed in [7] emphasises the concept of replaceability, highlighting how actors' centrality within networks augments their diplomatic influence. This study is particularly relevant for understanding how middle powers like Australia can leverage their positions in multilateral setting despite having less resources than other key players. In [8], an expandable knowledge graph was built from declassified foreign policy documents. The graph was then transformed into a unipartite format and PageRank used to identify the most influential diplomatic roles (e.g., US Secretary of State) [8]. This work is relevant as it validates the use of network analysis to understand diplomatic networks.

Several studies have utilised the GDELT dataset to analyse interaction patterns or for predicative tasks. For example, [9] developed a model to reveal the underlying causal network between countries and discover bilateral and multilateral relations. Finally, [10] used the GDELT dataset to classify events into conflict and cooperation and employed a Multi-input LSTM model to predict future trends. These studies collectively demonstrate the utility of large datasets and the potential of predictive tasks in network science and IR. They highlight how descriptive and data analysis approaches can be extended to predictive tasks, showing the next step in research if the value of network science for diplomatic strategies is fully recognised.

Data and graph construction

This report uses two datasets from the Lowy Institute, an independent Australian think tank. The first dataset is the 2024 Global Diplomacy Index, which includes information on the diplomatic networks of 66 countries over five years, from 2016 to 2023. It also contains socioeconomic indicators like population and GDP. This dataset is transformed into a series of weighted directed graphs, where each node represents a country and each directed edge from country A to country B indicates that A has a diplomatic post in B. The weight of an edge reflects the number of posts in a single country. For example, in 2023, Australia operates five posts in India. Note that this is not a complete graph of the global diplomatic network, as only 66 nodes out of 212 have outgoing edges.

The second dataset is from the Lowy Institute's Asia Power Index (API) and provides information on the economic, cultural, defence, and diplomatic networks of 26 countries. This report will focus on three variables: online search interest, foreign capital investment (FCI), and diplomatic dialogues. Three separate "network power" graphs were created from these attributes. In the graph created from online search interest, the edges are directed and weighted by the percentage of internet searches in 2021 from country A to country B, with outgoing edges from each node summing to 1. For the FCI graph, the edges are directed and weighted by the percentage of country B's ten-year cumulative FCI flows (2012-2021) coming from country A. Therefore, the incoming edges to each node sum to 1. The diplomatic dialogues graph has undirected edges weighted by the number of diplomatic dialogues held between country A and country B in 2021. The online search interest graph has 26 nodes and 556 edges, the FCI graph has 26 nodes and 362 edges, and the diplomatic dialogues graph has 24 nodes and 112 edges (North Korea and Taiwan are not represented).

Methodology

The methodology of this report involves analysing the two datasets and their respective graphs using network centrality measures, HITs and PageRank algorithms, community detection algorithms, and selected visualisations. This approach is designed to provide a comprehensive understanding of the data, uncover key insights, and identify strategic opportunities for improving Australia's regional influence.
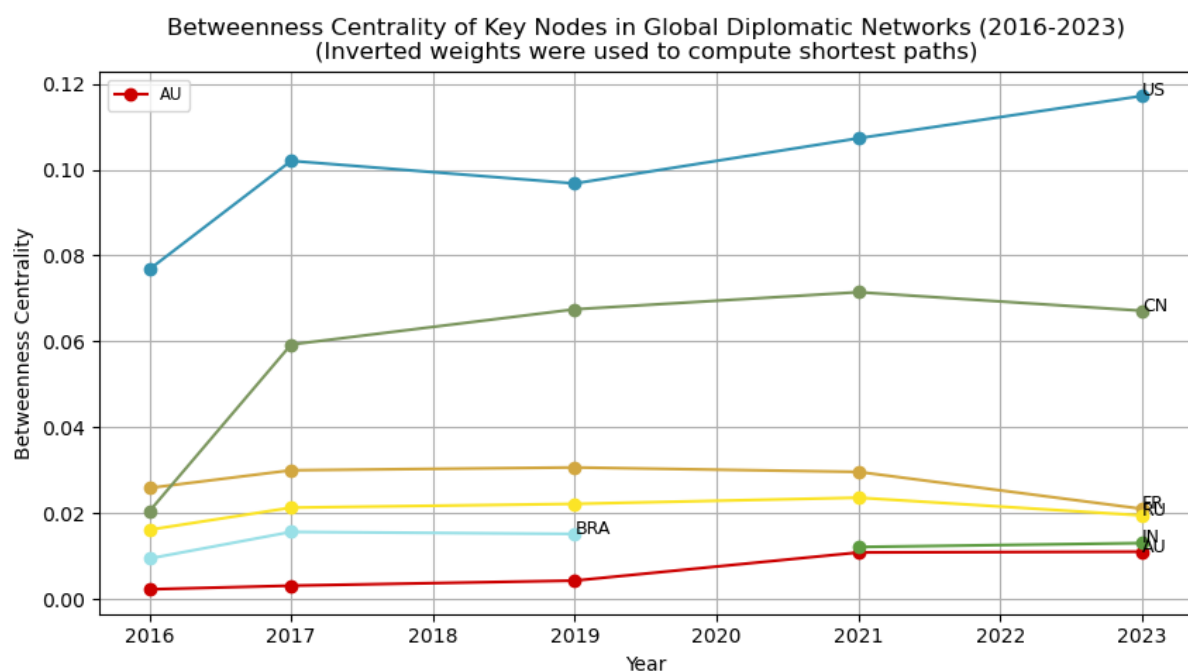
Global Diplomatic Networks
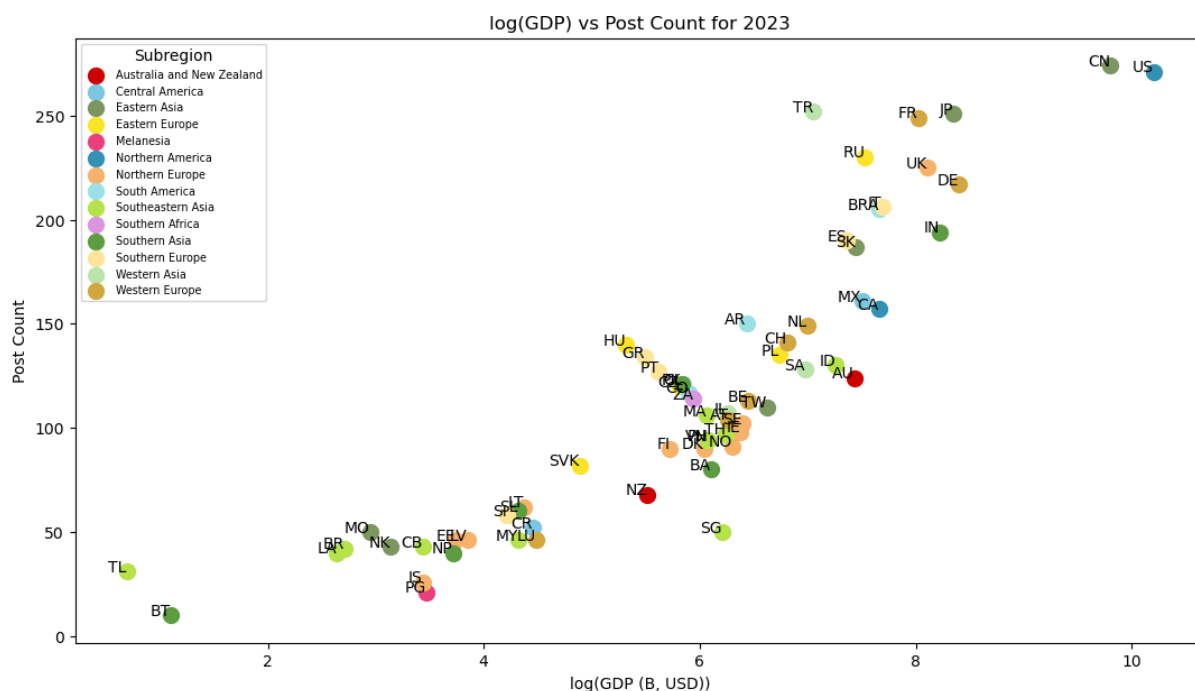
Australia's global diplomatic network has expanded by 9.73% since 2016, from 113 posts across 83 countries in 2016 to 124 posts across 89 countries in 2023. Despite this growth, Australia ranks 26th by the total number

of posts in 2023, which is relatively low considering its GDP. Looking at the scatterplot on page 1, among countries with similar GDPs, such as Mexico, Indonesia, and South Korea, Australia has the lowest number of posts. Australia's new posts have largely been opened in Oceania, with 7 new posts added from 2016 to 2023, bringing the total to 19, a 58.3% increase. In contrast, other great powers have been expanding outside their regions (see bar chart below). This strategy aligns with Australia's goal to strengthen its influence within the region, with the aim of amplifying its overall global presence and facilitating connections with major global powers. By focusing on regional leadership, Australia positions itself as a key player in the Indo-Pacific, potentially serving as a bridge to larger international powers.

New Posts Opened by Selected Countries by Region Since 2017
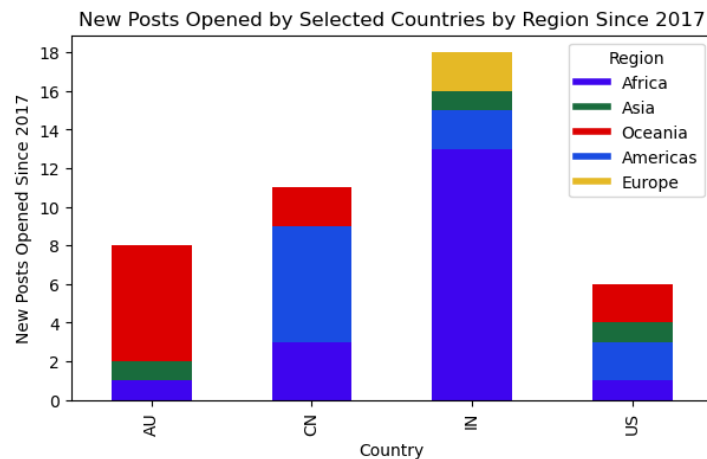
Top countries by weighted out degree (post count) 2023		
Rank	Country	# Posts 2023
1	China	274
2	United States	271
3	Turkey	252
4	Japan	251
5	France	249
25	Portugal	127
26	**Australia**	**124**
27	Chile	121

The line chart below shows the betweenness centrality of key nodes in the global diplomatic network from 2016 to 2023. Betweenness centrality measures the extent to which a node lies on the shortest path between other nodes, indicating its importance in facilitating interactions within the network. Edge weights were first inverted to account for the fact that higher weights indicate a greater connection between nodes. Australia's peripheral role in the global network in terms of physical diplomatic presence overseas is again highlighted. While Australia might not ever have the biggest diplomatic footprint, we now turn to three network power graphs to examine alternative international networks. By considering Australia's position in all these networks, we can identify the best strategies to enhance its influence globally.
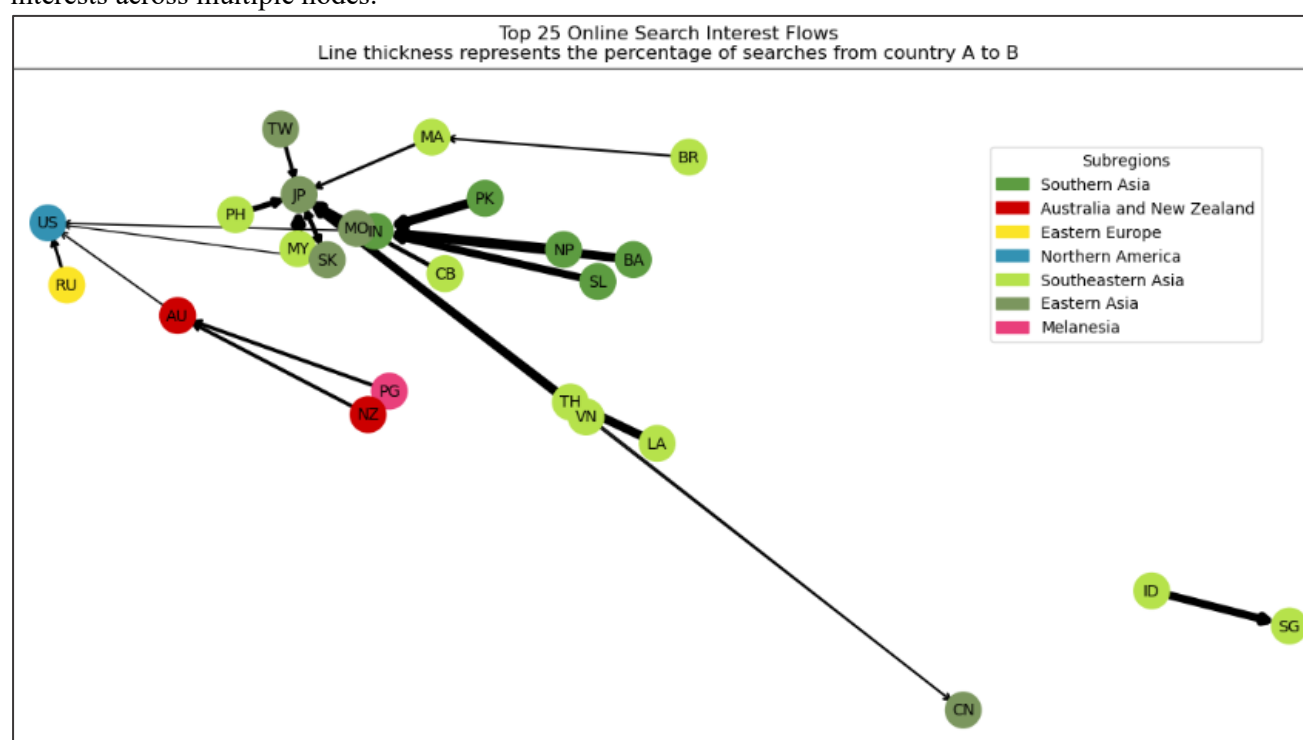

Betweenness Centrality of Key Nodes in Global Diplomatic Networks (2016-2023)
(Inverted weights were used to compute shortest paths)

Online Search Interest

The network visualisation below shows the top 25 online search interest flows, with nodes coloured by region and line thickness representing the magnitude of the flows. Japan and India stand out as key nodes in the network, with incoming edge weights of 5.31 and 3.43, respectively. China has the third-highest weighted in-degree at 2.84, slightly above the US at 2.81. Australia ranks 6th with a weighted in-degree of 1.43, just below Thailand at 1.53.

The fact that only one incoming edge into China appears in the top 25 suggests that China receives smaller amounts of interest from a wide variety of countries. India strongly dominates the interest of the Southern Asian region, while all regions show significant interest in the US.

The top 8 PageRank and HITS Authority scores, displayed in the table at the bottom of this page, further support these findings. If Australia wants to maximise its influence in this soft-power network, it could seek to build ties with India and Japan through cultural exchanges or infrastructure and business projects. These efforts have the potential to increase Australia's visibility and cause it to appear more frequently alongside these countries in search results, effectively leveraging a form of search engine optimisation.
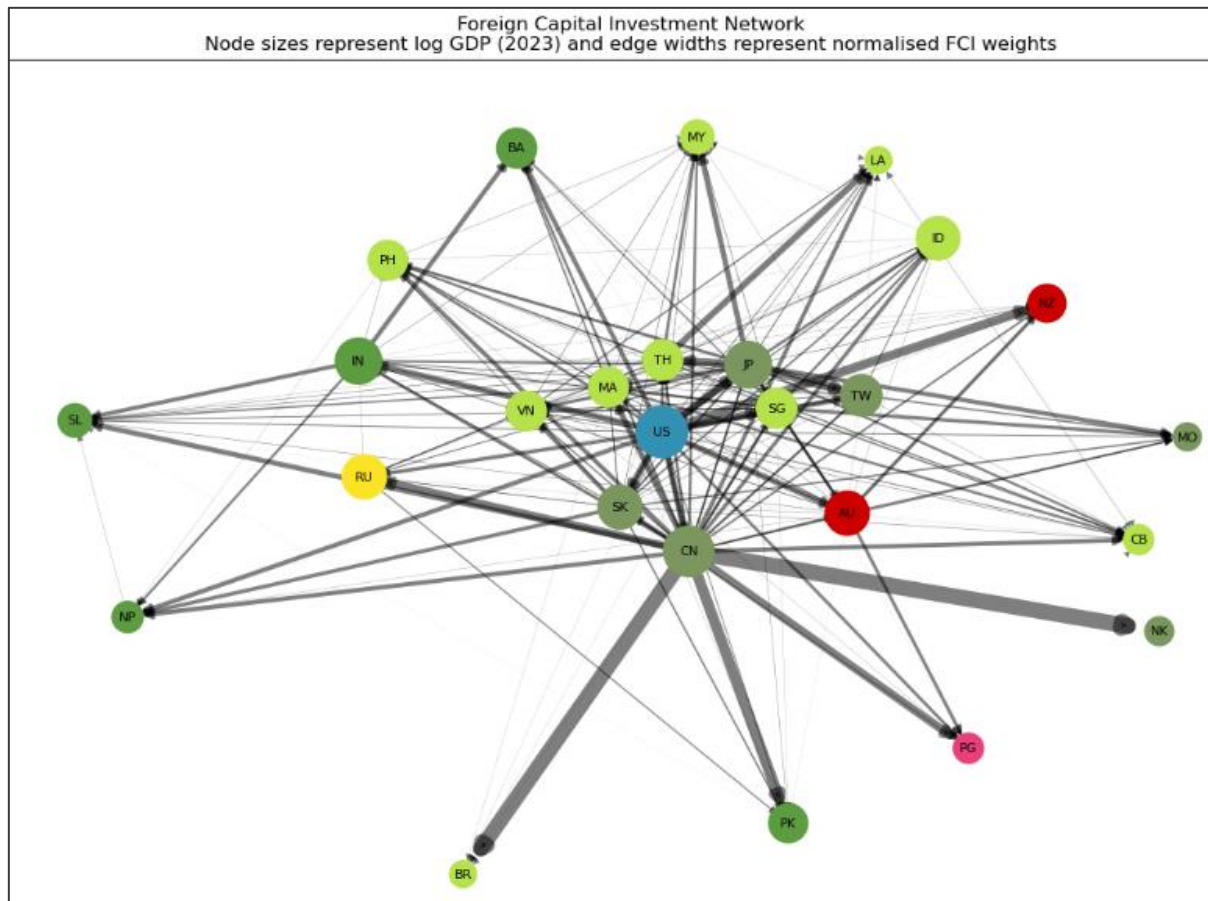
Interpreting the Hub scores is more challenging due to their relatively low values. Higher hub scores might be understood as indicating countries that are significantly influenced by a single major player, making it harder for Australia to increase its influence there. Instead, Australia should focus on countries with more widespread interests across multiple nodes.

Top 25 Online Search Interest Flows
Line thickness represents the percentage of searches from country A to B

Country	PageRank Score	Country	Authority Score	Country	Hub Score
Japan	0.15	**Japan**	0.24	**Myanmar**	0.06
United States	0.11	**India**	0.14	**Thailand**	0.06
China	0.11	**China**	0.12	**Vietnam**	0.05
India	0.09	**United States**	0.11	**Mongolia**	0.05
South Korea	0.07	**Thailand**	0.06	**Philippines**	0.05
Australia	0.05	**Australia**	0.05	**Nepal**	0.05
Thailand	0.04	**Singapore**	0.04	**South Korea**	0.04
Russia	0.04	**South Korea**	0.03	**Sri Lanka**	0.04

Foreign Capital Investment

The Indo-Pacific Foreign Capital Investment (FCI) network is visualised below, with China's regional dominance immediately evident. This is supported by a Hub score of 0.38, with the US having the second highest Hub score of 0.2. Australia score of 0.04, although the 6th highest, is still quite low, and Australia is not the primary sender of FCI to any country. Both China and the US provide more FCI than Australia to countries that are the top recipients of Australian FCI, namely Papua New Guinea and New Zealand.

Foreign Capital Investment Network
Node sizes represent log GDP (2023) and edge widths represent normalised FCI weights

The US and China each lead cumulative FCI flows to 10 countries, Japan to 4 countries, Thailand to 1 country (Laos), and South Korea to 1 country (Vietnam). Several countries, including Brunei, North Korea, and Pakistan, are heavily dependent on China. Clearly, Australia cannot compete with China in this regard, especially given China's raw 10-year cumulative FCI is over 500% greater than Australia's regional investments.

Rather, Australia needs to focus on the quality rather than quantity of investments in countries where China is a key player, but perhaps could compete with Japan to maximise influence in those countries where Japan currently provides the greatest share of FCI such as Thailand and Vietnam. Further, the government could encourage Australian businesses to diversify their investments in the Indo-Pacific region to augment the government's own contribution, targeting sectors where Australia has competitive advantages, such as agriculture, mining, and services.

Diplomatic Dialogues

Finally, we investigate the diplomatic dialogues network. The image at the top of page 6 highlights a particular area of the network structure, showing a stronger connection between the United States, Japan, and Australia compared to India, the fourth member of the QUAD diplomacy and security dialogue. This group is

a key part of the regional architecture, whose governments are aligned in their shared concerns about China's increasingly assertive behaviour in the region. Russia appears to be a key mediator between China and India, even though these two countries do not themselves have a strong diplomatic connection.

Diplomatic Dialogues Network (Raw Values)
Edge thickness represents number of diplomatic dialogues held between country A and B
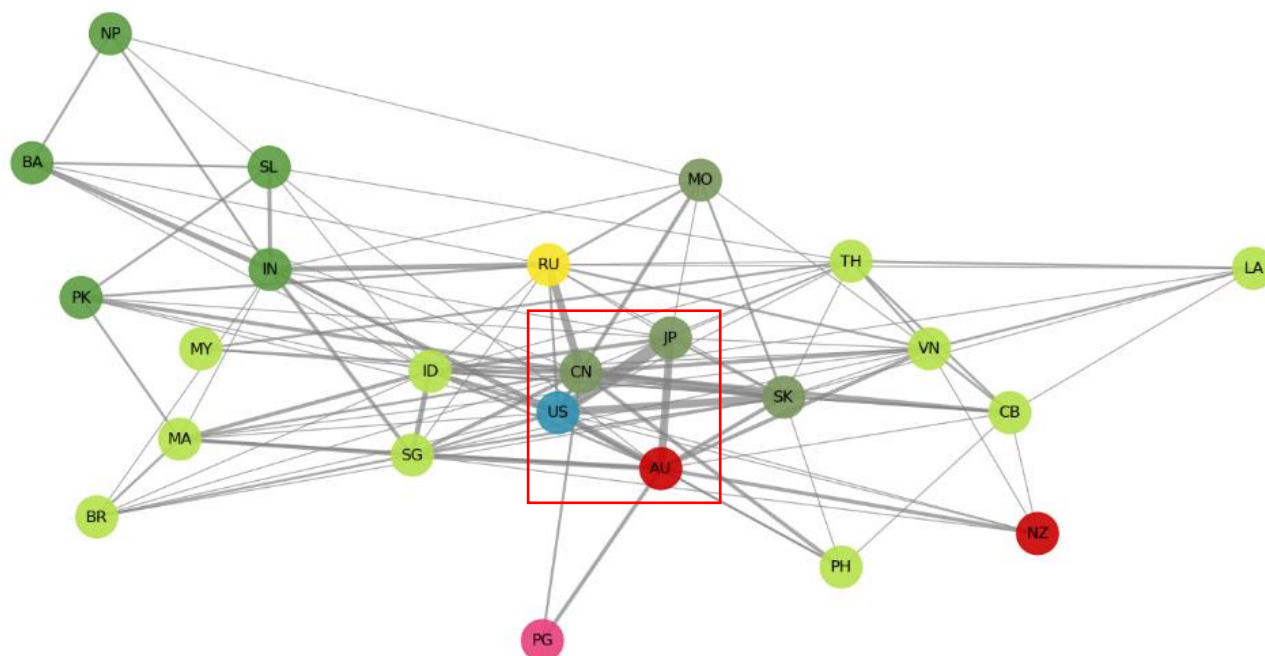
By weighted degree, China (46), the US (40), and Australia (36) lead the pack. Interestingly, Indonesia and China, followed by South Korea, the US, and then Australia (tied with Vietnam and Russia), have the most diverse set of diplomatic dialogues (unweighted degree). Their unweighted degrees are as follows: Indonesia and China 17, South Korea and the US 14, and Australia 14. Australia should be careful not to put itself at odds with a key strategic player like Indonesia, which is closest to being a de facto leader of ASEAN. Over-investing in US-led "minilateral" alliances could risk this. Instead, Australia should aim to increase diplomatic engagement with a broader range of regional countries. Of the networks analysed, Australia has the highest PageRank ranking in the diplomatic dialogue network, with the third highest score after China and the US. This suggests that Australia could best maximise its regional influence through increased investment of time and resources in deepening engagement in regional diplomatic fora.

Community Detection

Finally, Louvain community detection, an algorithm used to identify communities in large networks by optimising modularity, was conducted on each of the network power graphs. Modularity, a measure of the structure of networks, was calculated to test the strength of these found communities. The adjusted Rand index (ARI) was used to compute the similarity between each network, quantifying the agreement between different community structures. The results are displayed in the table below.

	Online Search Interest	Foreign Capital Investment	Diplomatic Dialogues
Modularity	0.216	0.184	0.234
Communities	{0: ['AU', 'PG', 'NZ'], 1: ['BR', 'ID', 'SG', 'MA'], 2: ['NP', 'SL', 'IN', 'PK', 'BA'], 3: ['US', 'NK', 'VN', 'JP', 'PH', 'MY', 'SK', 'TW', 'RU', 'MO', 'CN'], 4: ['CB', 'LA', 'TH']}	{0: ['NP', 'IN', 'SL', 'BA'], 1: ['US', 'JP', 'SK', 'TW'], 2: ['CB', 'MA'], 3: ['AU', 'SG', 'NZ', 'MO', 'ID'], 4: ['MY', 'VN', 'TH', 'PH', 'LA'], 5: ['PK', 'PG', 'RU', 'BR', 'NK', 'CN']}	{0: ['BR', 'ID', 'SG', 'MA'], 1: ['US', 'SK', 'AU', 'PG', 'JP', 'NZ', 'PH'], 2: ['NP', 'IN', 'SL', 'BA'], 3: ['PK', 'VN', 'LA', 'CB', 'MY', 'TH', 'RU', 'MO', 'CN']}

The ARI between the Online Search Interest (OSI) and Diplomatic Dialogues (DD) communities was 0.324, 0.199 between the OSI and Foreign Capital Investment (FCI) communities and 0.188 between the DD and FCI communities.

The DD network, shown on page 7, had the highest modularity score (0.234), indicating that it has the most well-defined community structure among the three networks, although it was not much greater than the modularity of the OSI network. However, even the highest modularity score was still quite low. This could be attributed to countries belonging to multiple overlapping communities in global networks, high inter-community connections or the small size of the network. The greater similarity between the OSI and DD network compared to either with the FCI network community structure suggests that there is a moderate similarity in how countries group together based on public interest and diplomatic interactions. This can be attributed to the overlapping influences of cultural ties, media, and global events. In contrast, the FCI network's community structure is driven by distinct economic factors, resulting in lower ARI scores when compared with OSI and DID networks.

Louvain Communities in the Diplomatic Dialogue Network with Edge Weights
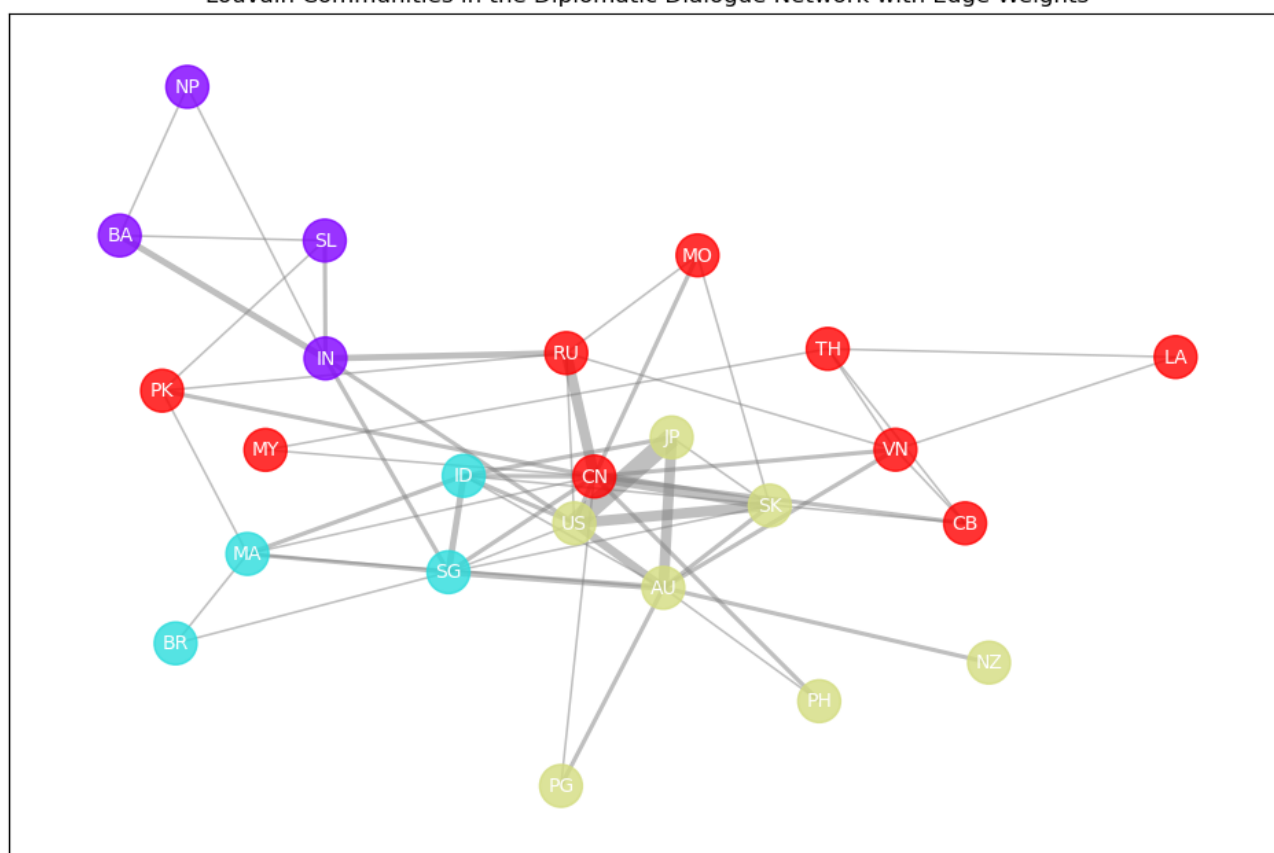
Australia's grouping with New Zealand across all networks suggests a strong and consistent regional relationship. In the FCI network, Australia is grouped with a mix of Southeast Asian countries, indicating economic ties beyond its immediate geographic region. In the DID network, Australia's inclusion in a community with the US and Japan reflects significant diplomatic relationships with major global powers and regional allies. However, the lack of strong community structure makes it hard to formulate any concrete policy recommendations from this initial analysis.

Findings

The analysis of Australia's influence in the Indo-Pacific region using network science tools has yielded several key insights. The findings underscore Australia's strategy of strengthening its regional presence through opening new diplomatic posts in nearby locations and its engagement in economic and cultural networks.

However, the results also highlight limitations and opportunities for improvement. Firstly, the expansion of Australia's diplomatic network, particularly within Oceania, aligns with its goal to bolster regional influence. Despite this growth, Australia still ranks relatively low in terms of the total number of diplomatic posts compared to countries with similar GDPs. This suggests that while Australia is making strides in enhancing its regional presence, there is still room for improvement in its global diplomatic reach. The focus on Oceania is strategic, but expanding diplomatic efforts beyond this region could further amplify Australia's influence.

The analysis of the online search interest network revealed that Australia is a net receiver of interest, ranking 6th in weighted in-degree. This indicates a moderate level of global attention towards Australia. To maximise its influence, Australia should consider strengthening ties with key nodes like India and Japan through cultural exchanges and business projects. These efforts could enhance Australia's visibility and influence in the digital sphere.

The Foreign Capital Investment network highlighted China's dominant role in the region, with Australia having a relatively low hub score. While Australia cannot match China's investment volume, it can focus on the quality of investments and target sectors where it has a competitive advantage or offers distinct benefits. For instance, as a democratic nation with strong ties to the US and other Western countries, Australia can leverage its political stability and favourable international relations to attract investments and foster partnerships that might not be as readily pursued with China.

In the diplomatic dialogues network, Australia ranks high in PageRank scores, indicating its strategic importance in regional diplomatic engagements. This suggests that Australia could best enhance its influence by deepening its engagement in regional diplomatic for a, acting as a key broker between other nations. However, Australia must balance its alliances to avoid over-reliance on US-led initiatives, which could strain relations with key regional players like Indonesia.

Community detection analysis showed that Australia's network relationships are multifaceted, with consistent regional ties to New Zealand and economic connections to Southeast Asian countries. The moderate similarity between the online search interest and diplomatic dialogues networks suggests that cultural and diplomatic ties overlap, while economic factors drive the distinct community structure of the FCI network.

Limitations

Several limitations affect the findings of this study. The dataset was not comprehensive, covering only 66 out of 212 countries, and lacked extensive time series data, which restricts the ability to extend the analysis to predictive tasks. A more complete diplomatic and influence network structure, covering a broader range of countries and time periods, would provide a more accurate and detailed understanding of global dynamics.

Dataset noise and sampling bias also pose challenges. The data may not fully capture informal or unreported diplomatic engagements, and the focus on specific variables might overlook other influential factors in the network power dataset. Future research could explore additional variables supplied in the network power dataset to provide a more holistic view of Australia's diplomatic and economic influence.

Conclusion

Leveraging network science for International Relations offers valuable insights into Australia's regional standing and influence in the Indo-Pacific. While the results of this study were not particularly surprising, the alignment of findings with common understandings of global relations indicates that network science methods and techniques can effectively reveal underlying structures in various international contexts. This suggests that network science provides a fruitful path for future research, which could delve deeper into time series analyses and incorporate more variables to uncover new insights and support strategic policy development. Expanding on these methods can help refine strategies and optimise Australia's diplomatic efforts in a competitive global landscape.

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Link to code and datasets

https://github.com/ClaireLouiseR/COMP8880

Impact statement

This paper presents an exploratory analysis aimed at enhancing Australia's influence in the Indo-Pacific region using network science methodologies. The goal is to advance the understanding of international relations through network analysis, and the findings are intended for academic and theoretical purposes only.

There are no significant ethical concerns or specific societal implications to highlight, as the study does not involve sensitive data or experimental interventions. Additionally, the research is conducted independently of any direct policy formulation or decision-making processes.