

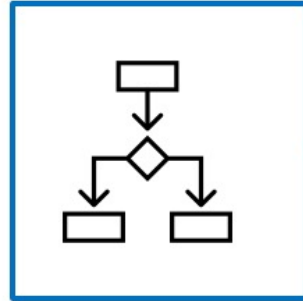
Arms Trade Network Analysis

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Agenda

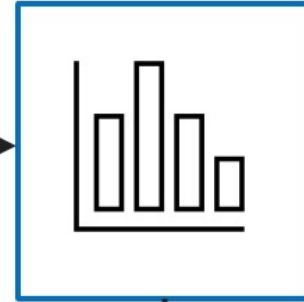
01

Project Overview



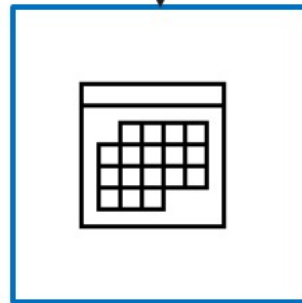
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High-Level Analysis



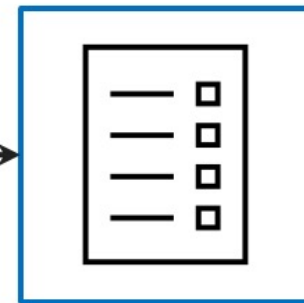
03

Temporal Analysis



04

Conclusion



01: PROJECT OVERVIEW

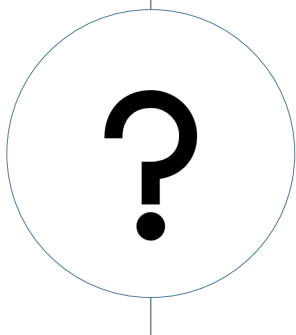
Project Description & Motivation

Goal: Build a global arms deal transaction network that contains information from the past 70+ years including countries, categories of arms transactions, and suppliers/buyers.



Description

- Arms deals are agreements between countries to sell equipment
 - Artillery, aircrafts, armored vehicles, etc.
- Deals have monetary value, but we are focusing on breadth of deals



Motivation

- Estimate of financial value of global arms trade \geq \$119 billion in 2019 alone
 - True figure likely higher
- Identify leading countries in the global arms trade over time
- Determine behavior of countries (suppliers & buyers) during conflict

Data Description

- Stockholm International Peace Research Institute (SIPRI); contains deals since 1950
- Organization was established in the 1966 in Sweden to commemorate 150+ years of Swedish peace
- Snippet included; data was compiled using a bash script due to initial readability issues with rtf file

	YearOrdered	AmountOrdered	YearDelivered	Designation	Category	Description	AmountDelivered	Buyer	Seller
0	2011	12.0	2011	PM-43 120mm	Artillery	Mortar	12.0	Burkina Faso	Albania
1	1980	4.0	1980	N-262 Fregate	Aircraft	Transport Aircraft	4.0	Angola	Algeria
2	1967	2.0	1968	Il-28	Aircraft	Bomber Aircraft	2.0	Nigeria	Algeria
3	2016	3.0	2016	BTR-60PB	Armoured vehicles	Apc	3.0	Western Sahara	Algeria
4	1979	1.0	1979	Noratlas	Aircraft	Transport Aircraft	1.0	Congo	Angola
...
27760	1970	2.0	1971	G-2A Galeb	Aircraft	Trainer Aircraft	2.0	Zambia	Yugoslavia
27761	1970	4.0	1971	J-21 Jastreb	Aircraft	Ground Attack Ac	4.0	Zambia	Yugoslavia
27762	1989	1.0	1990	DHC-4 Caribou	Aircraft	Transport Aircraft	1.0	Liberia	Zambia
27763	2000	10.0	2001	2S1 122mm	Artillery	Self-Propelled Gun	10.0	Czechia	Zimbabwe

02: HIGH-LEVEL ANALYSIS

Network Overview

Type:

Weighted, Directed Graph

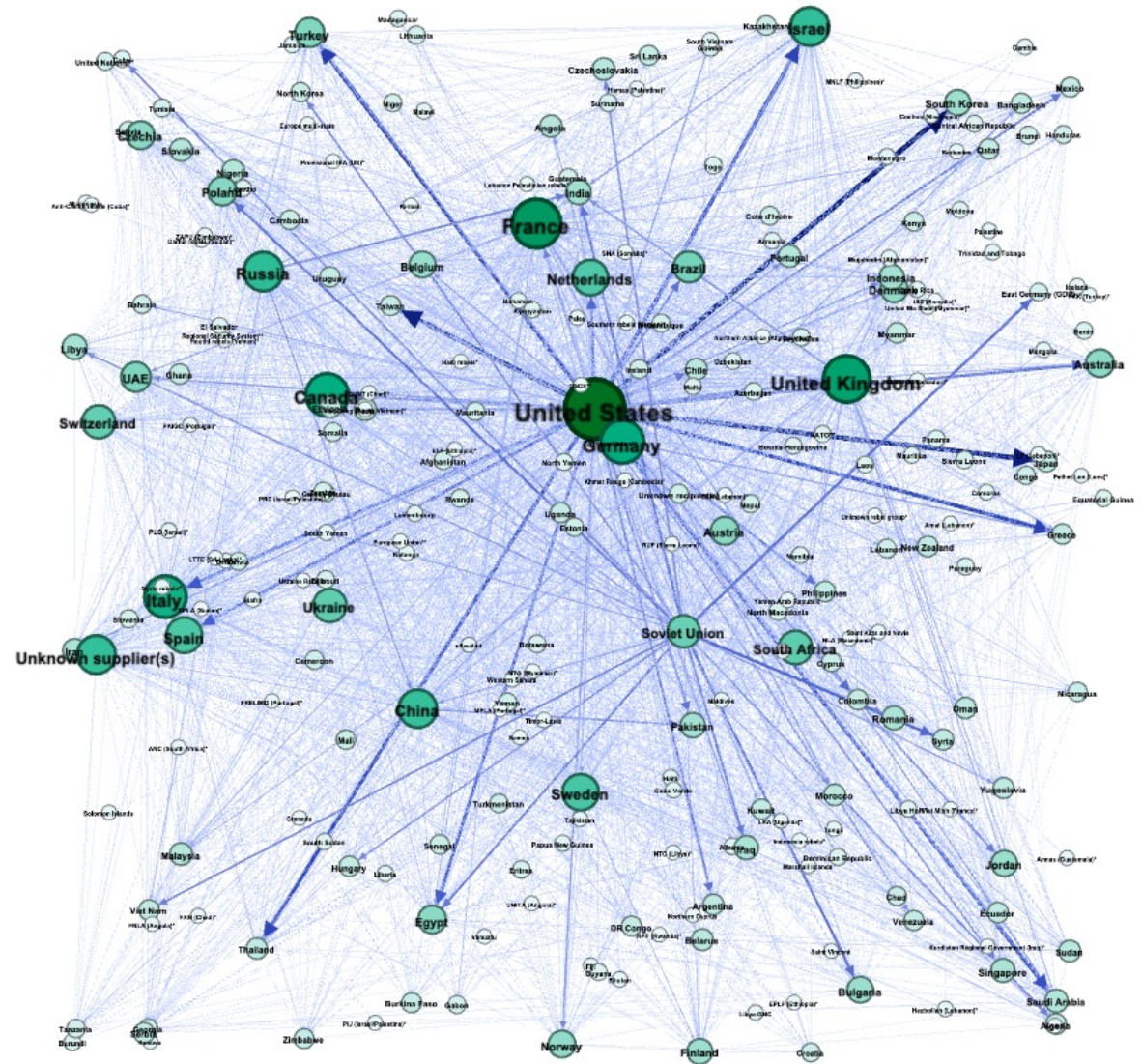
Nodes :

Individual Countries

Edges :

Each edge: number of arms deals between two countries

Outgoing edge is the supplier and the node with the incoming edge is the buyer.



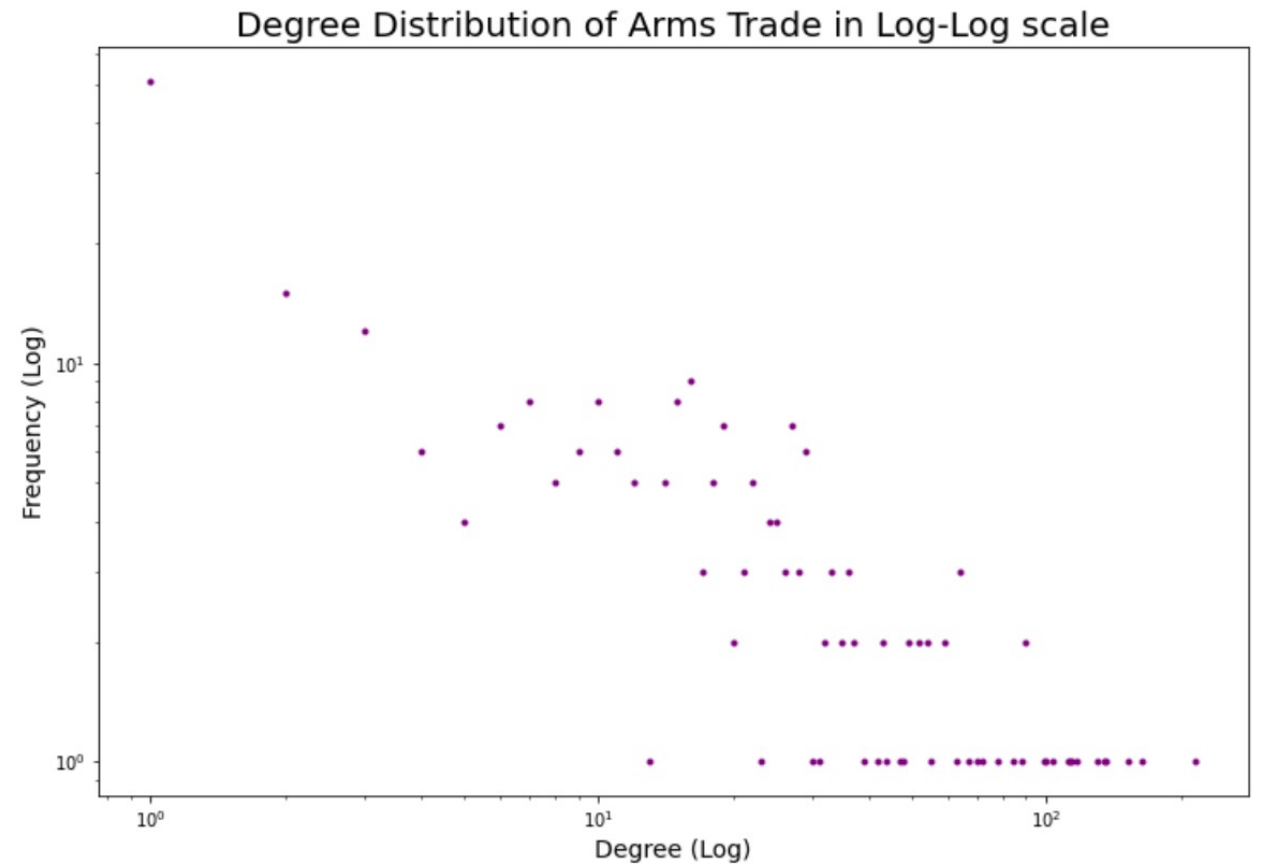
Network Statistics

Nodes: 264

Edges: 2,992

Average SP length: 1.189

Clustering Coefficient: 0.330



Closeness and Degree Centrality Leaders

Country	Closeness Centrality Score
United States	0.227
Iraq	0.225
Nigeria	0.223
Jordan	0.217
Indonesia	0.215

Country	Degree Centrality Score
United States	0.817
France	0.620
United Kingdom	0.578
Germany	0.517
Canada	0.510

Betweenness and Eigenvector Centrality Leaders

Country	Betweenness Centrality Score
United States	0.127
France	0.037
Israel	0.036
United Kingdom	0.034
Jordan	0.027

Country	Eigenvector Centrality Score
Iraq	0.160
Jordan	0.154
Nigeria	0.151
Indonesia	0.151
Pakistan	0.148

Reciprocity

- ♦ **Definition:** the ratio of the number of edges pointing in both directions to the total number of edges in the graph.
 - ♦ Single node: ratio of the number of edges in both directions to the total number of edges attached to node u .
- ♦ **Formula:** $r = |{(u, v) \in G}|{|(v, u) \in G}|{|(u, v) \in G}|$
- ♦ **Our Interest:** reciprocity for arms trade analysis can reveal behavior about countries as related to how much they act as **suppliers & buyers** with countries they engage with
 - ♦ Countries with high reciprocity both buy and sell from countries they engage rather than have a one-way relationship

Reciprocity Leaders

Country	Reciprocity	Degree
Finland	0.462	52
Norway	0.441	59
Denmark	0.373	59
Sweden	0.369	103
Jordan	0.333	54

- Data shows that Nordic countries deal with each other most often as both buyers & suppliers
- United States: 0.288 reciprocity & degree of 215, serves as a supplier for many smaller countries as opposed to a buyer
- El Salvador was removed from the leaderboard as its degree was only 2

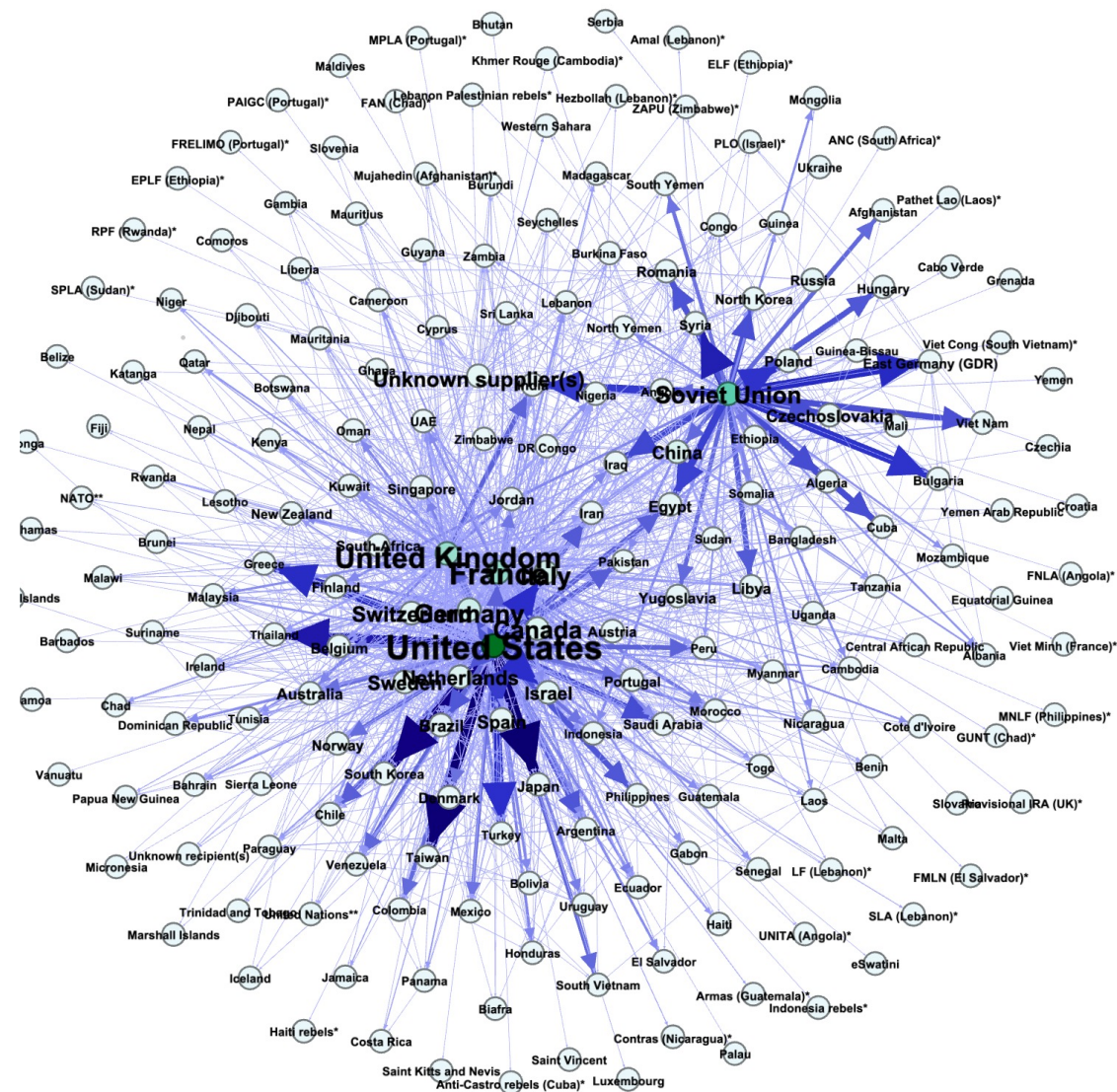
03: TEMPORAL ANALYSIS

Period 1 – Cold War [1947-1991]

Country	In-Degree
Egypt	0.115
Iraq	0.110
Iran	0.110
Morocco	0.100
India	0.100

Country	Out-Degree
United States	0.665
France	0.550
United Kingdom	0.526
Germany	0.411
Italy	0.411

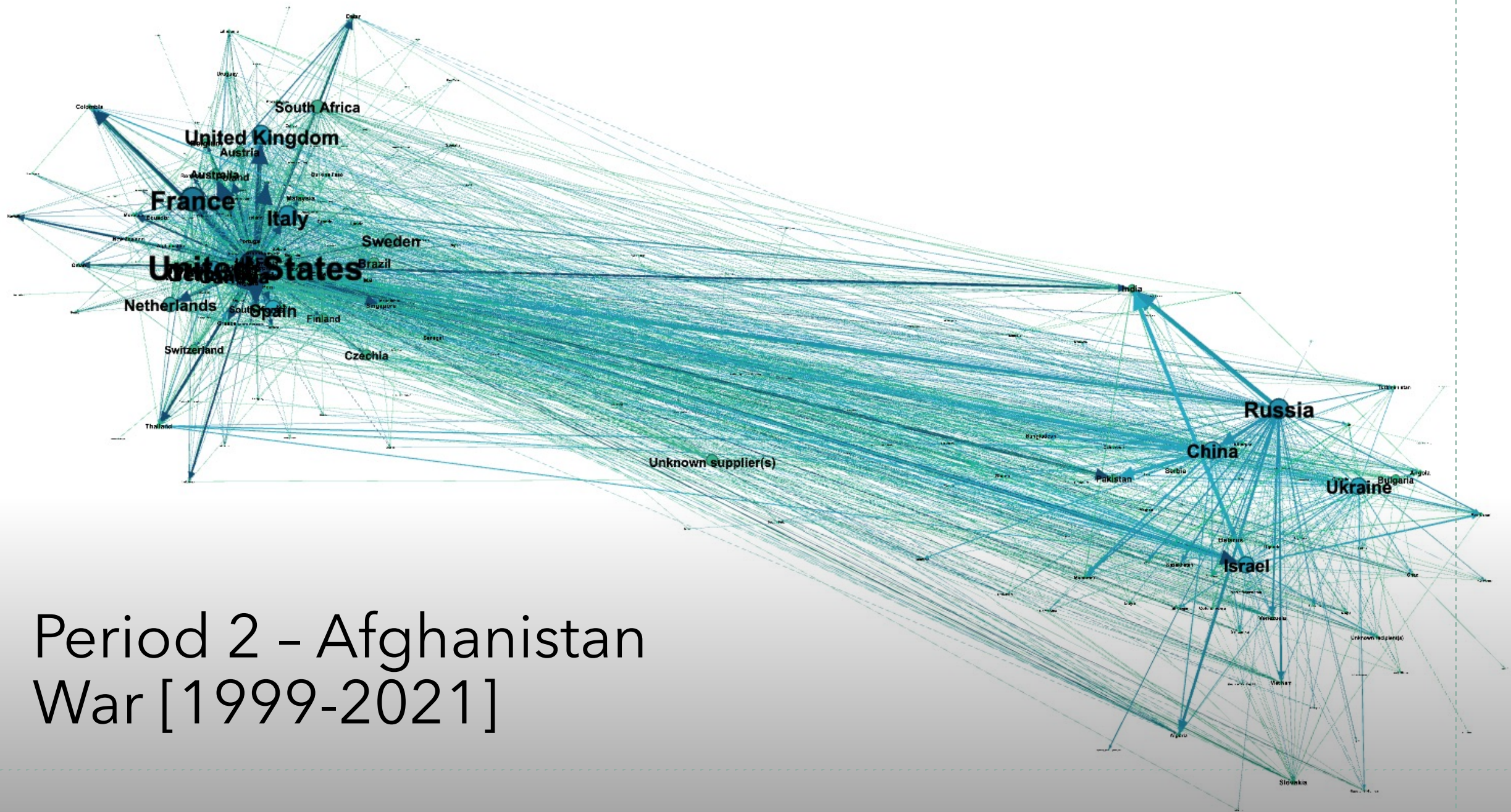
Period 1 - Cold War [1947-1991]



Period 2 - Afghanistan War [1999-2021]

Country	In-Degree
Indonesia	0.142
UAE	0.137
Iraq	0.132
United States	0.127
Malaysia	0.123

Country	Out-Degree
United States	0.651
France	0.505
Russia	0.448
Italy	0.425
Germany	0.410



Community Visualization of Afghanistan War Period



04: CONCLUSION

Summary

01 Superpowers across time periods tend to be the most central suppliers. However, we see variation in the most central buyers during these periods.

02 Reciprocity gives an interesting take on trading hubs by finding groups of countries that exhibit high back-and-forth arms trade activity.

03 We see clear community partitions during the Afghanistan war period, but this may be due to inherent political relations not related to the war period.

Next Steps



References

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- Kinsella, David. "Mapping the Small Arms Trade: Insights From Social Network Analysis ." , Portland State University, Mar. 2004, pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1020&context=polisci_fac.
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