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# United Nations Temporal Network Analysis

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# Agenda

- Data Description
- Analysis
  - Countries' influence change over history
  - Countries' Affinity
  - Homophily or social influence?
- Conclusion

# Data Description

- UN voting record from 1946-2015
- Resolutions: UN resolution, subject, and vote records
- Member state votes: Individual member state votes per resolution
- Annual summary of votes: annual summary of member state voting records with affinity scores

# Part I - Country's Influence

- Defining influence
  - Degree centrality: the # of links incident upon a node
  - Closeness: the average length of the shortest path between the node and all other nodes in the graph
  - Betweenness: quantifies the number of times a node acts as a bridge along the shortest path between two other nodes
  - Current flow Closeness and Betweenness: measure closeness and betweenness for each node but considers total information flow through each node in calculations
  - Eigenvalue centrality: relative scores are assigned to all nodes in the network based on the concept that connections to high-scoring nodes contribute more to the score of the node in question than equal connections to low-scoring nodes
  - Loading Centrality: the fraction of all shortest paths that pass through that node
  - **Combined Influence**: summed centrality measure z-scores for a given node

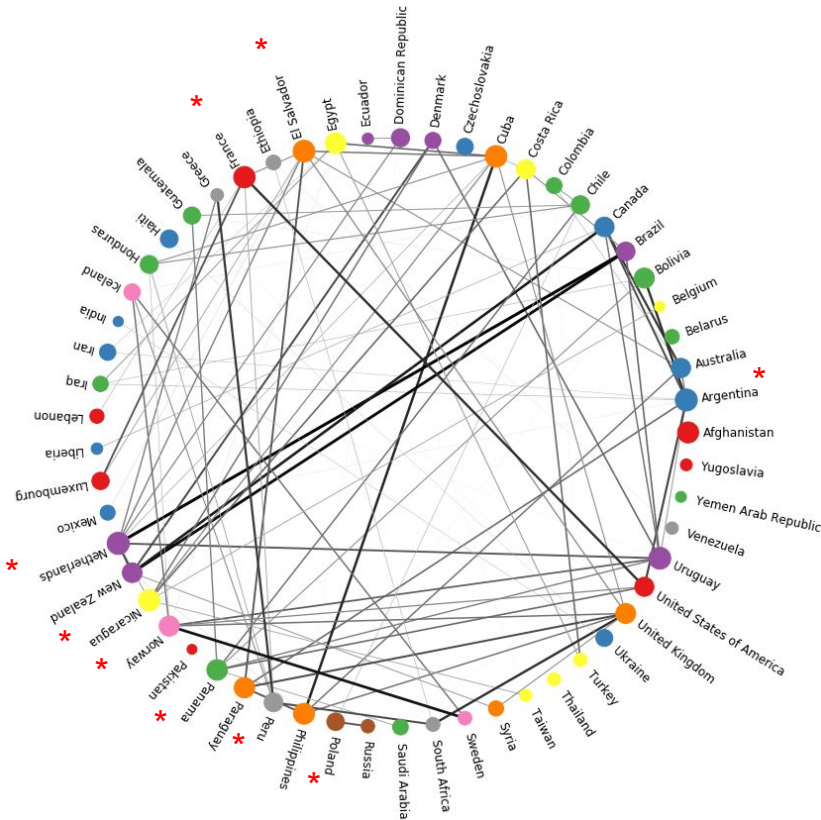
# Finding Communities within the Network

- Can we find meaningful subgraphs within the overall network?
- We broke the network into communities by finding the best partition of the network according to modularity
  - Def. Modularity - the fraction of the edges that fall within the given groups minus the expected fraction if edges were distributed at random
    - Communities have dense connections between members within the community but sparse connections with those outside the community
- A community should theoretically reflect countries with strong shared interests
- Within a community top influencers were determined according to the aforementioned centrality metrics

# Network Graph Legend

1. Node size is based on combined influence score. Large node = bigger influencer
2. Node color corresponds to community they belong to (determined by modularity of node in network, i.e., function of network structure)
3. Darker edge colors correspond to greater number of shared votes
4. Red stars indicate the country within a community with the greatest combined influence score

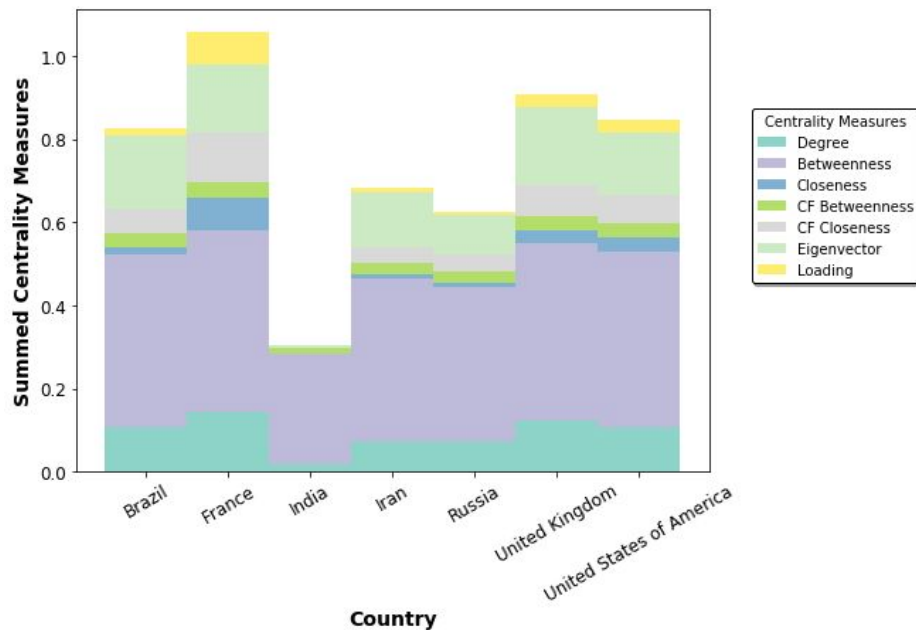
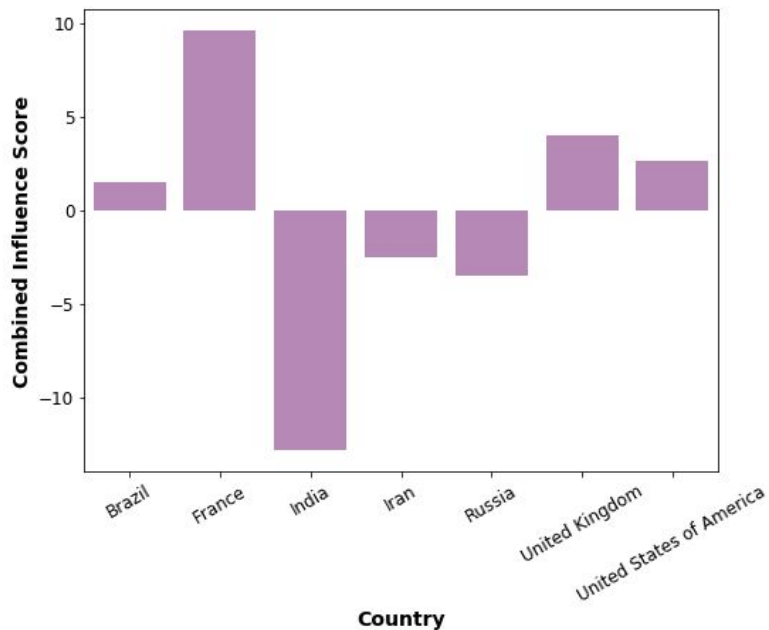
# 1946-1947: Pre-Cold War



- Prior to the Cold War there were many different communities (9) within the UN
- However, within these communities there were not that many strong ties and as many countries seemed to vote both with and without their other community members
- Lack of solidarity could be due to rescrumbling after end of WWII

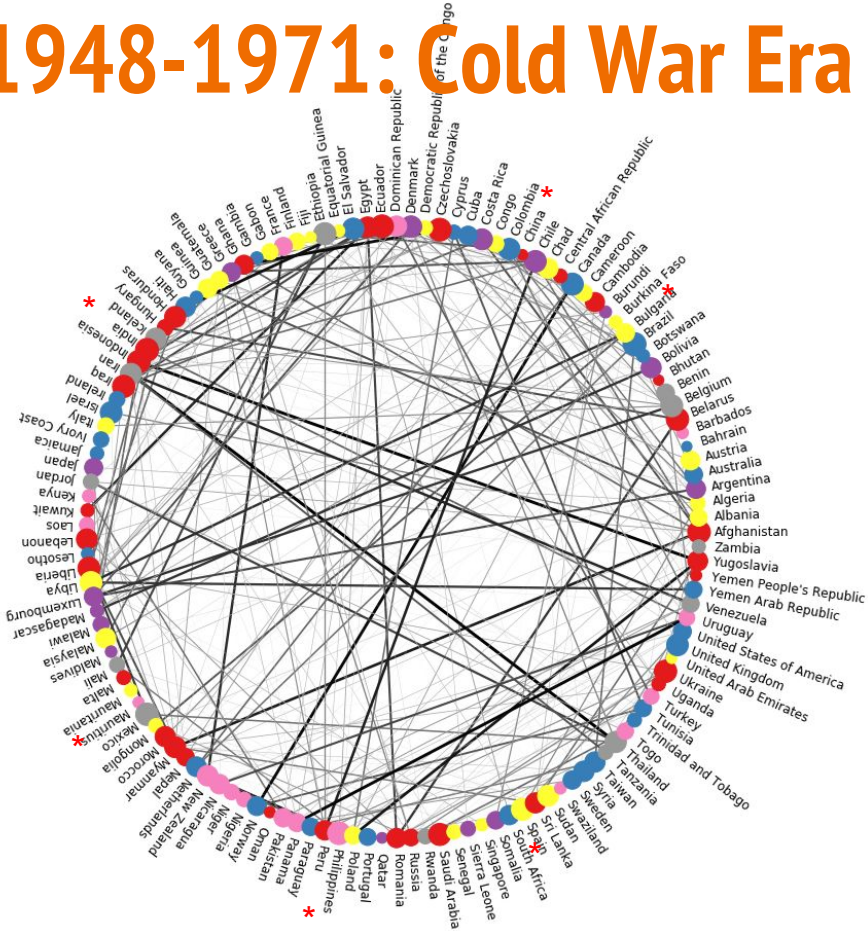
# 1946-1947: Pre-Cold War

Just after WWII and prior to the Cold War France had a high amount of influence within the UN





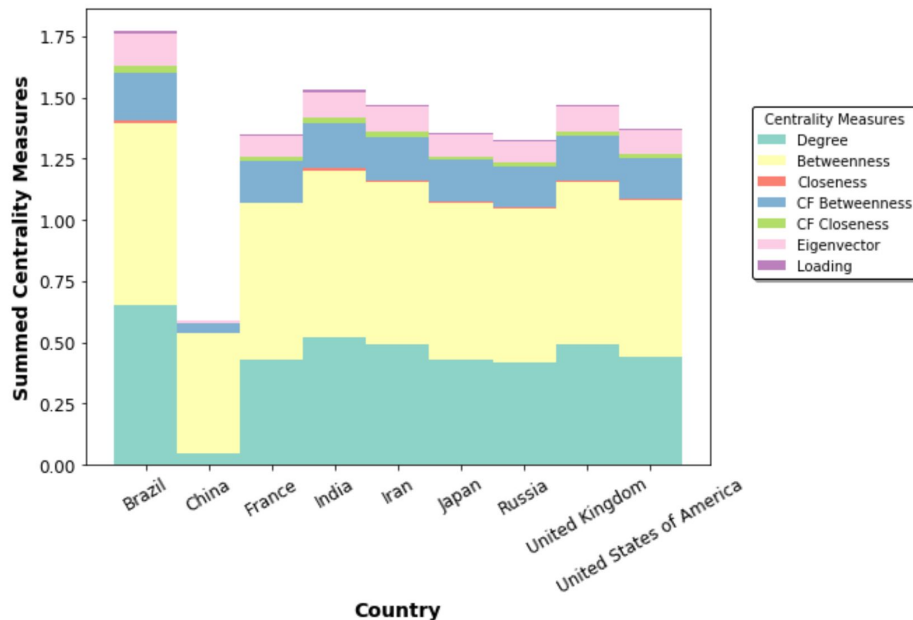
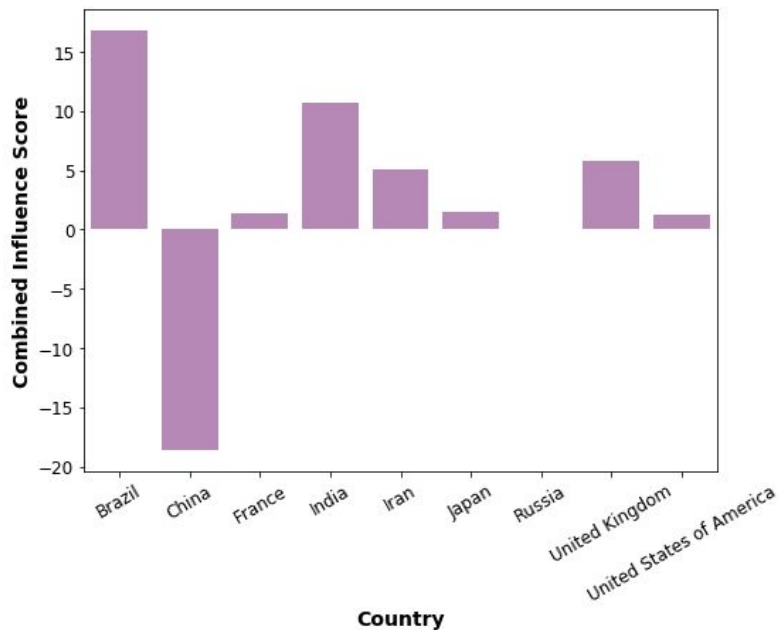
# 1948-1971: Cold War Era



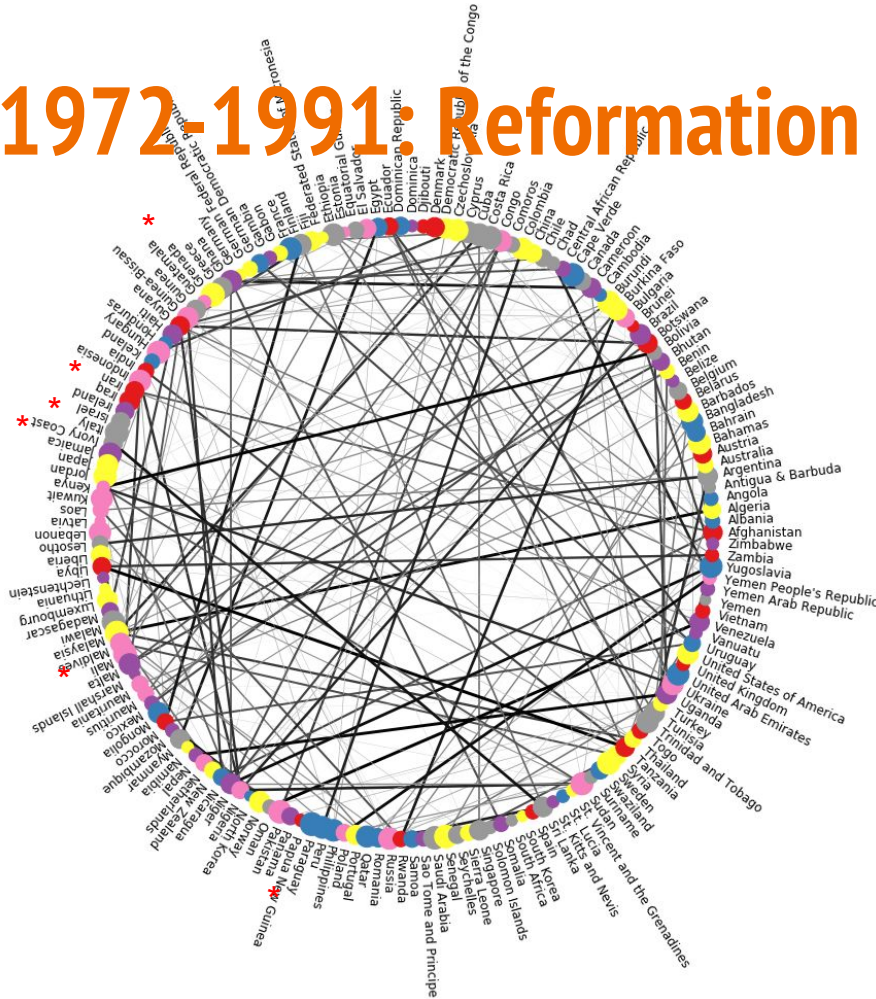
- During the cold war era, the number of communities shrinks (6)
- However, the strength of ties within communities strengthens
- This shift could represent alignment either the Western axis or USSR

# 1948-1971: Cold War Era

Surprisingly, during the Cold War the U.S. and Russia did not have the highest influence metrics within the UN



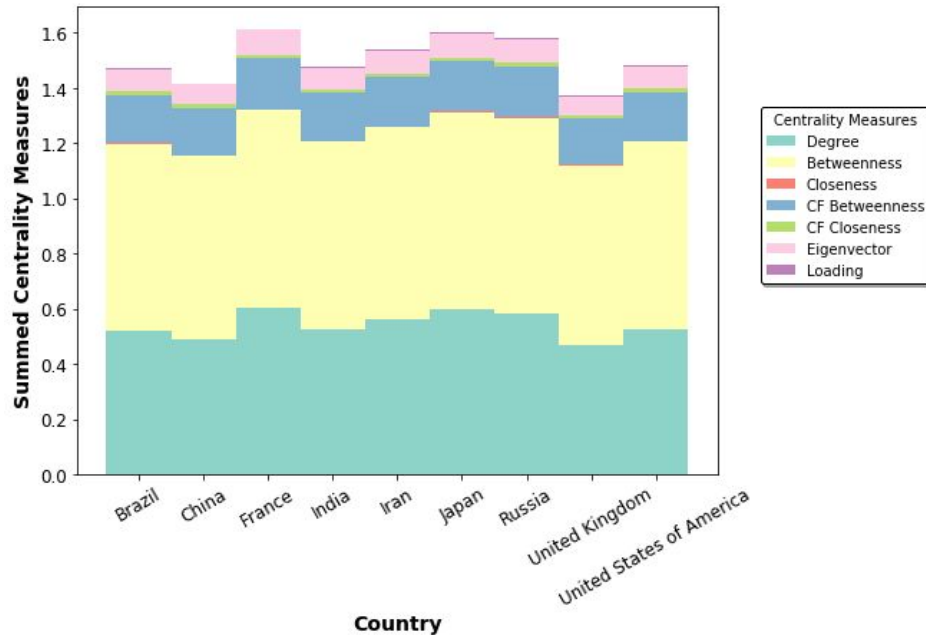
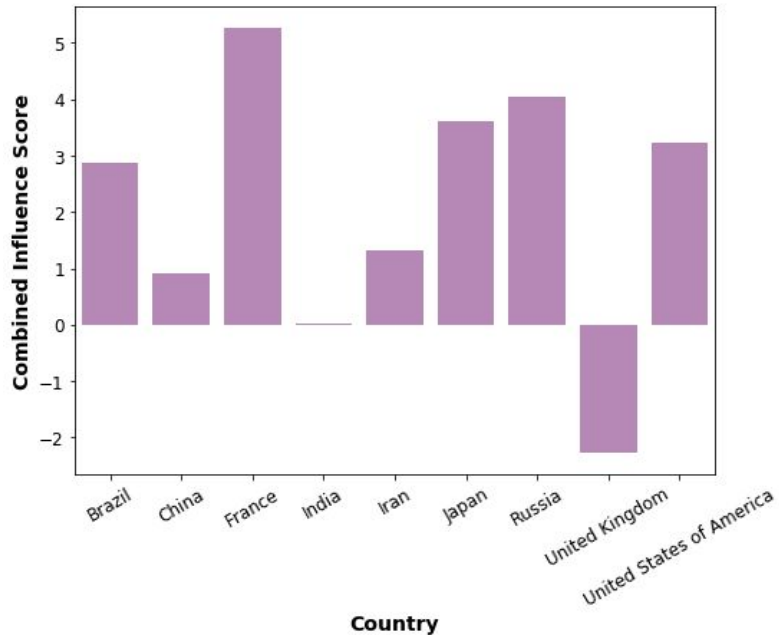
# 1972-1991: Reformation Era



- During the reformation era there seems to be an increasing number of strong ties
- The number of communities remains unchanged (6)
- May reflect continued alliances until the end of the Cold War
- Opening of diplomatic between The United States and China results in two countries belonging to the same community

# 1972-1991: Reformation Era

After China established diplomatic relations with the U.S. their influence dramatically increased



# 1992-2001: Post Soviet Union Collapse

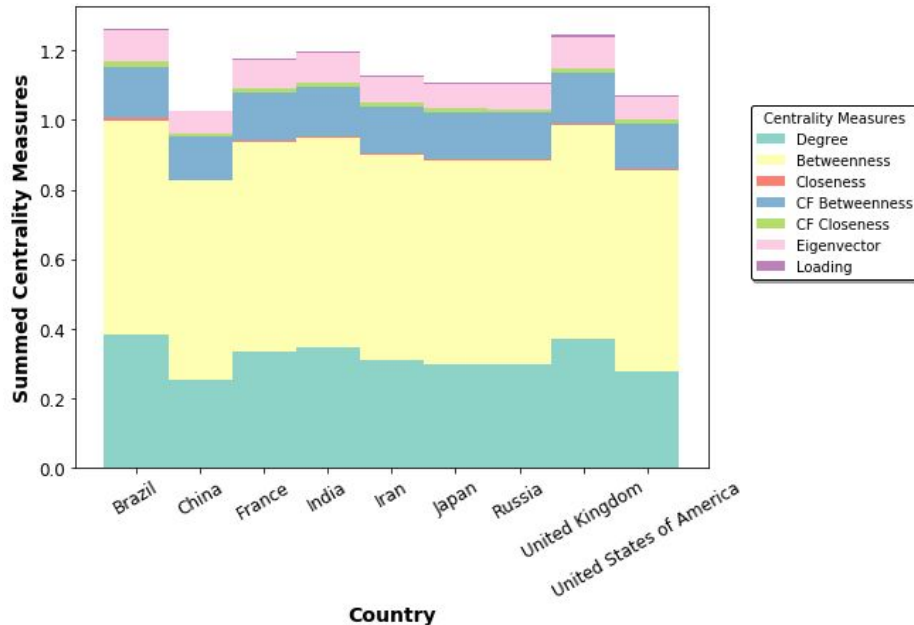
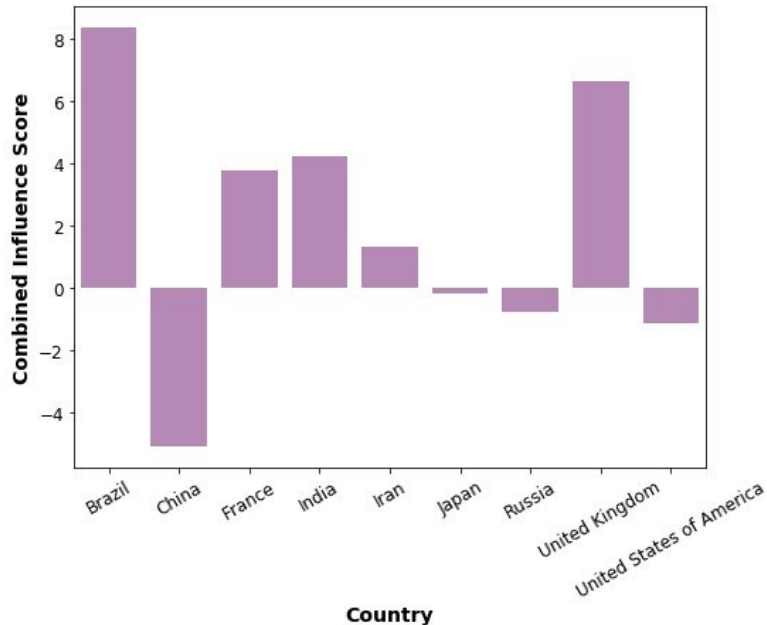


- After the cold war era and the fall of the USSR there appears to be fewer strong ties and an increase in number of communities (8)
- As the USSR dissolved new countries were formed and alliances made, thus resulting in the expanded number of communities and weaker ties

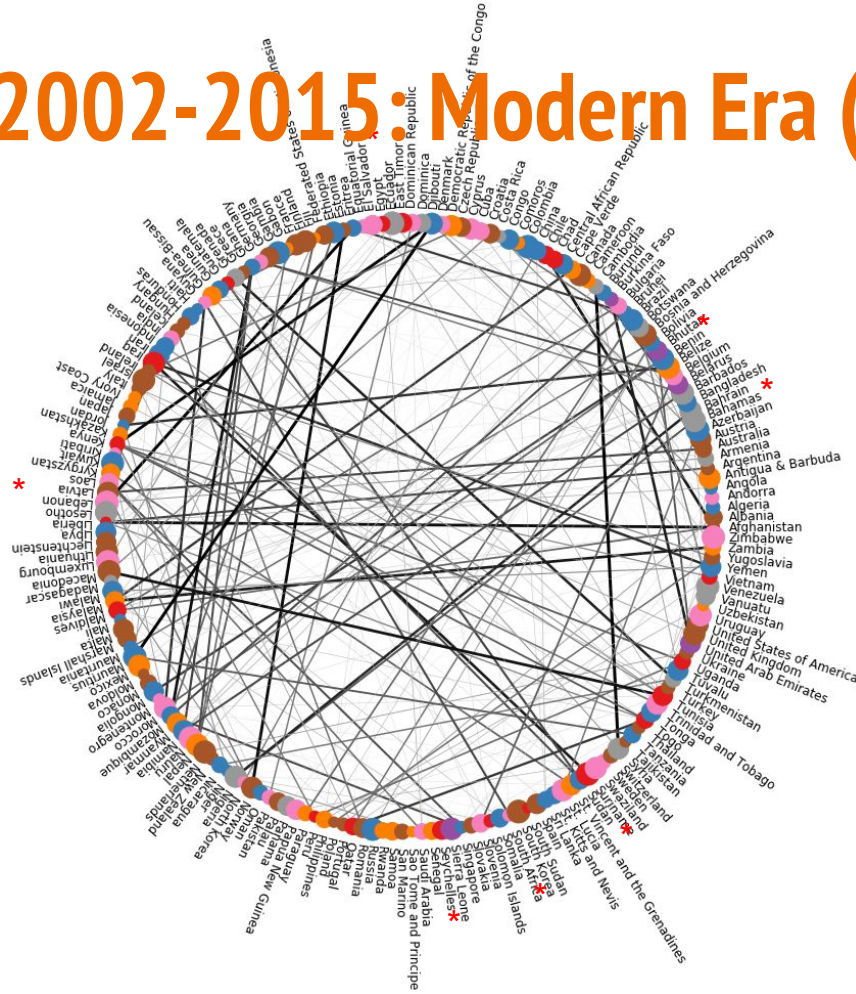


# 1992-2001: Post Soviet Union Collapse

The United Kingdom returns to prominence in terms of influence within the UN



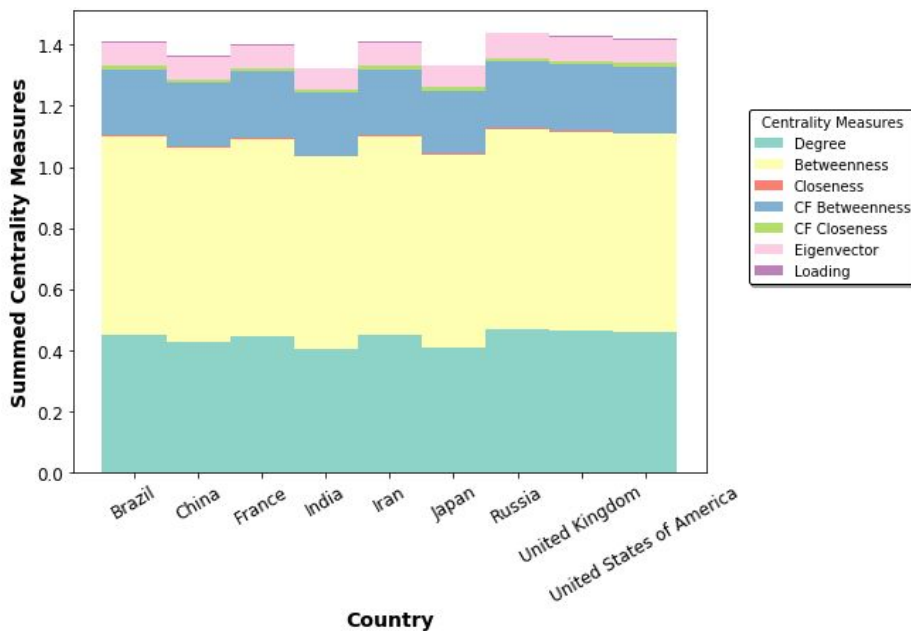
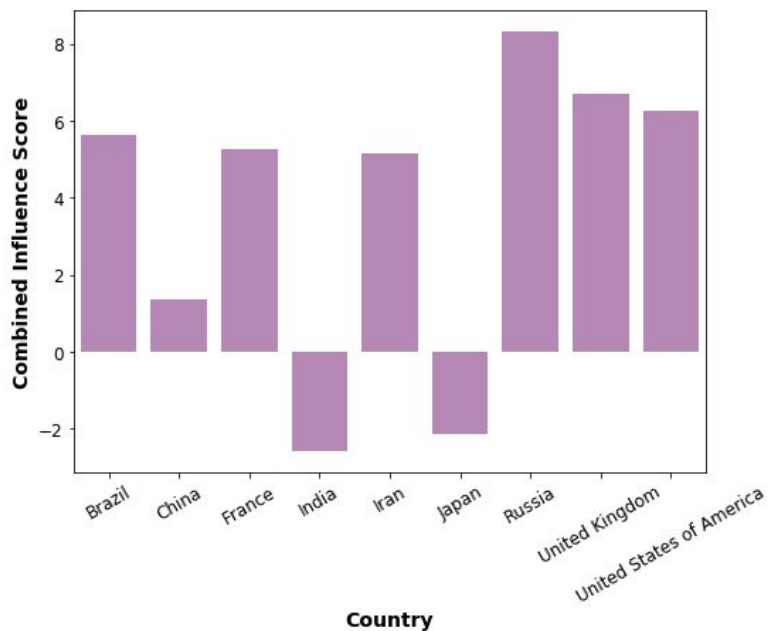
# 2002-2015: Modern Era (Post 9/11)



- In the modern era a reconsolidation of countries into a smaller number of communities (7) has occurred
- However, there does not seem to be a resultant strengthening of ties amongst countries within the same community
- China is now within the same community as Russia and apart from the U.S., reflecting a change in alignment amongst the world powers

# 2002-2015: Modern Era (Post 9/11)

The U.S., Russia, and prominent European countries exert the greatest influence



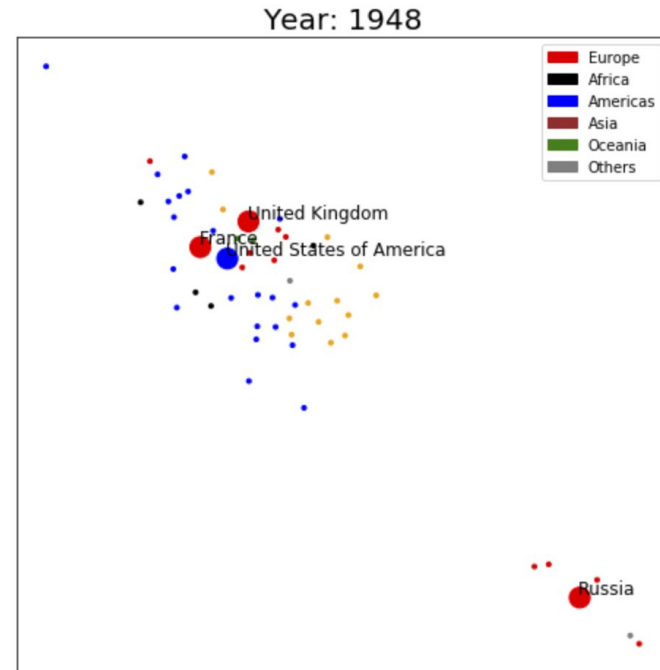
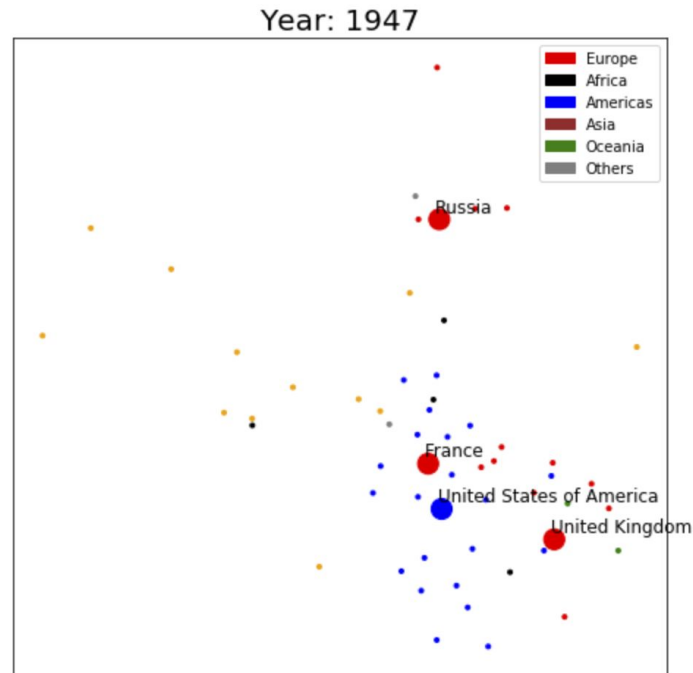


# Part II - Countries' Affinity

- Concept definition
  - In one year, country A voted  $n$  times, country B voted  $m$  times and they voted the same for  $k$  times
  - The affinity score defined as  $(k/n + k/m)/2$
- Question: can the change in affinity score over years indicate big historical events?
- Approach: MDS map to visualize the affinity

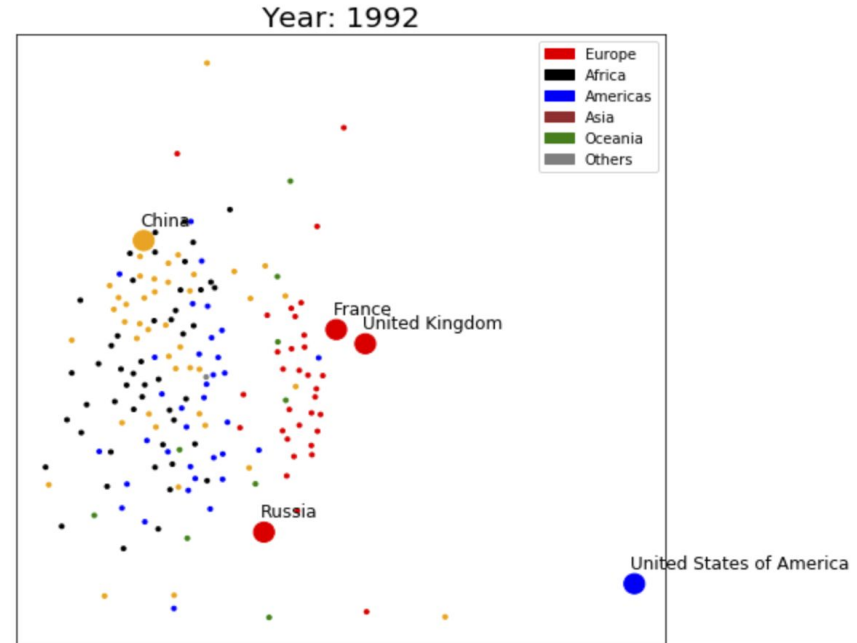
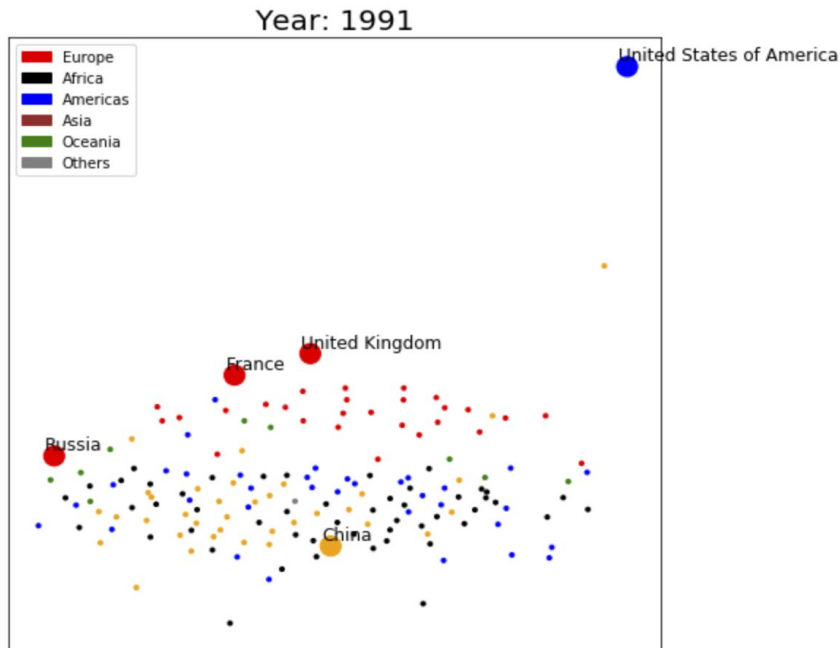
# Truman Doctrine (1947) & the Cold War

Western & Eastern countries choose sides as tensions escalate



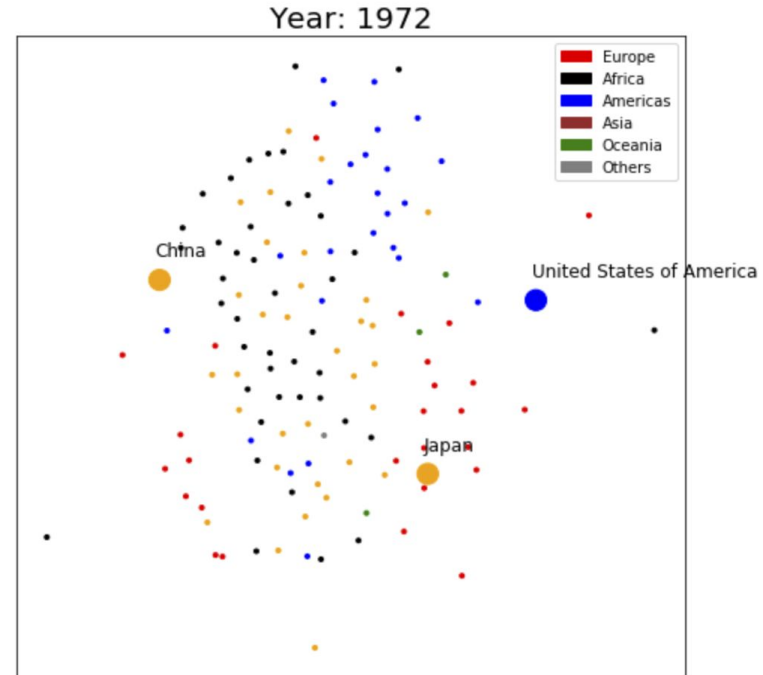
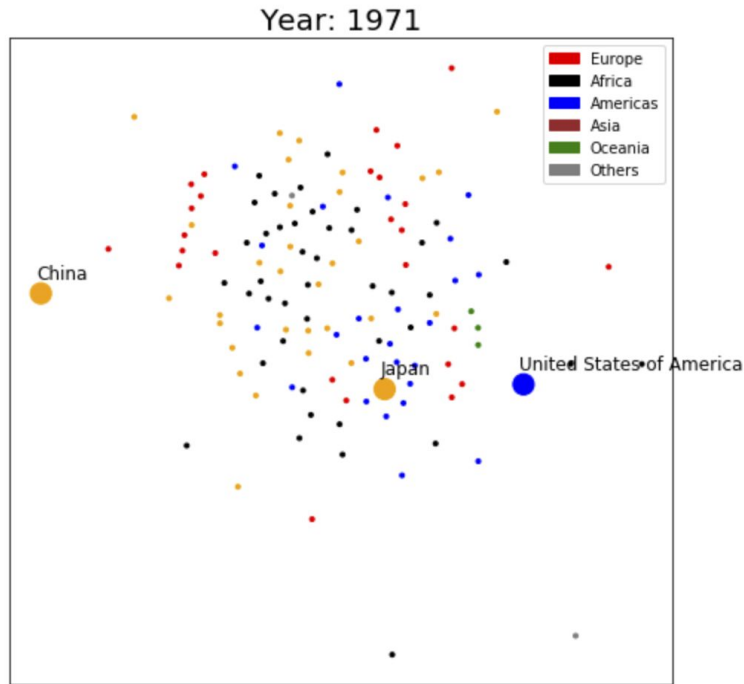
# End of the Cold War

The Cold war ended in December 1991. Tension between Western and Eastern blocs quell. China becomes the representative communist country



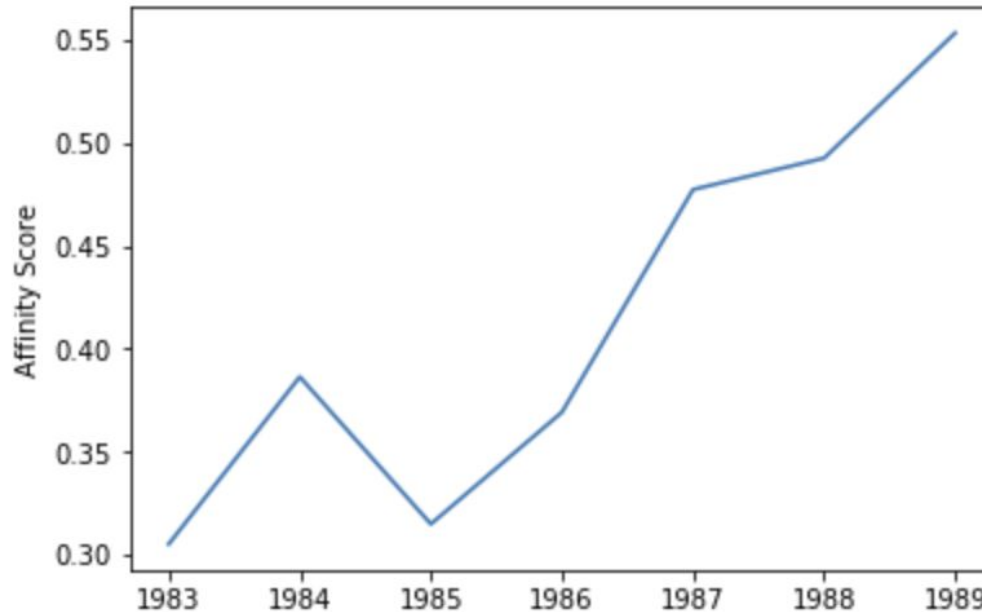
# Chinese Relations with Japan & the US

China established diplomatic a relationship with Japan and the US in 1971 & 1972, respectively



# Merging of Two Germany's

The affinity score between the German Federal Republic and the German Democratic Republic rose, leading up to their merging in 1990.



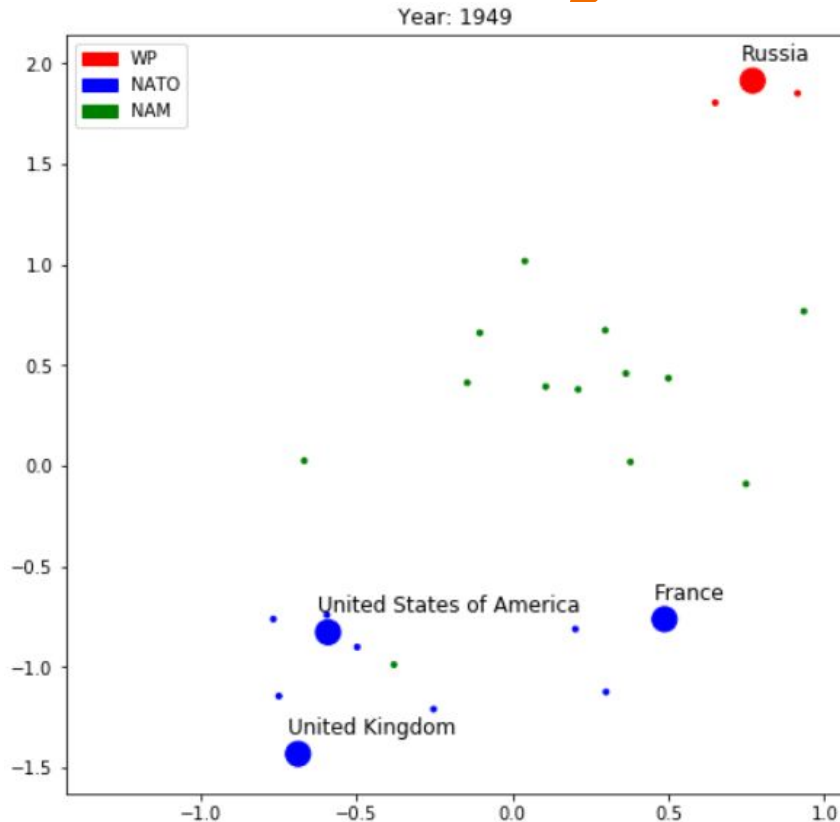
# Political & Economic Organizations Post-WWII

How do the affinity scores shift over time for countries involved in:

- NATO (The North Atlantic Treaty Organization)
- WP (Warsaw Pact)
- NAM (Non Alignment Movement)

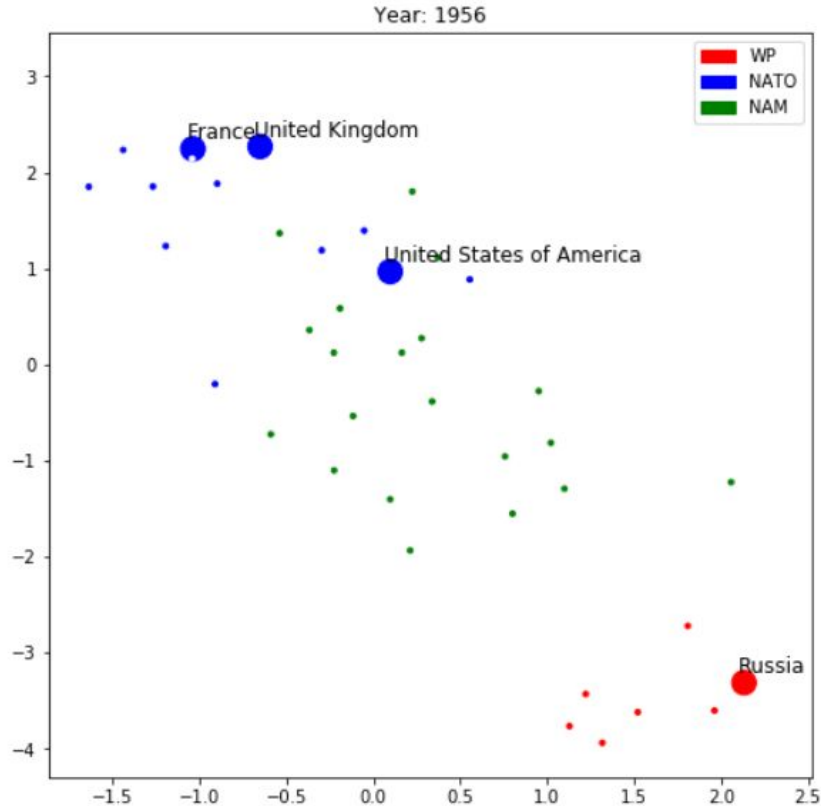


# Before These Organizations were Founded



Allegiances were clearly visible before the institutionalization of the groups

# First Year Following their Founding



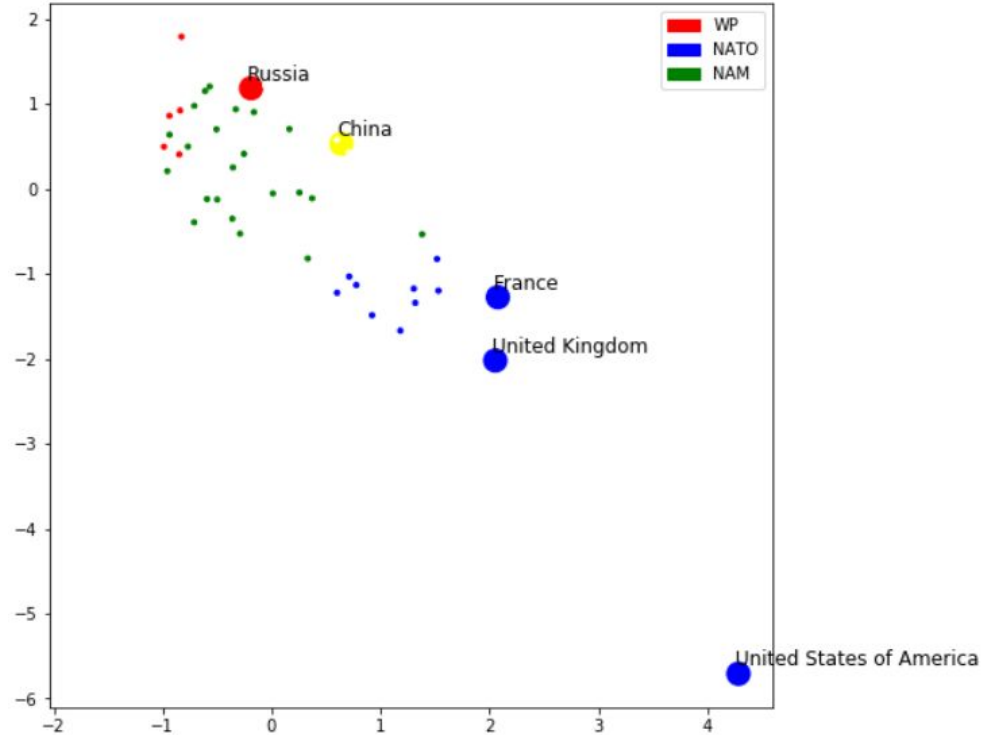
NAM positioned as the 'middle ground'

This kind of pattern holds true until Gorbachev's political & economic reforms

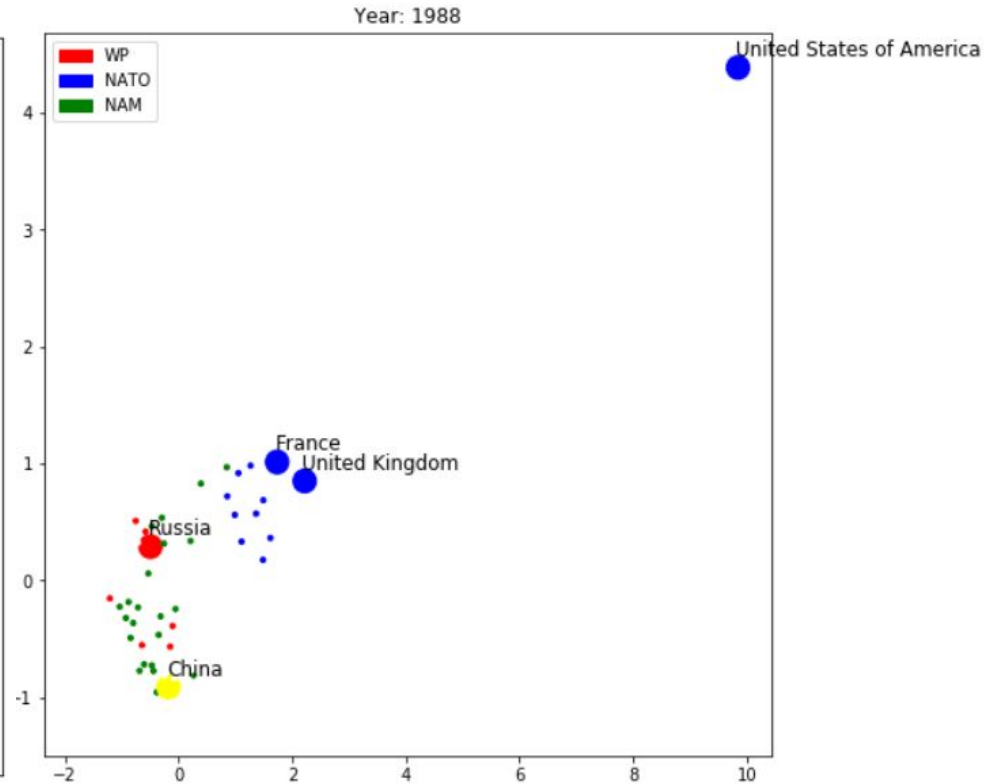
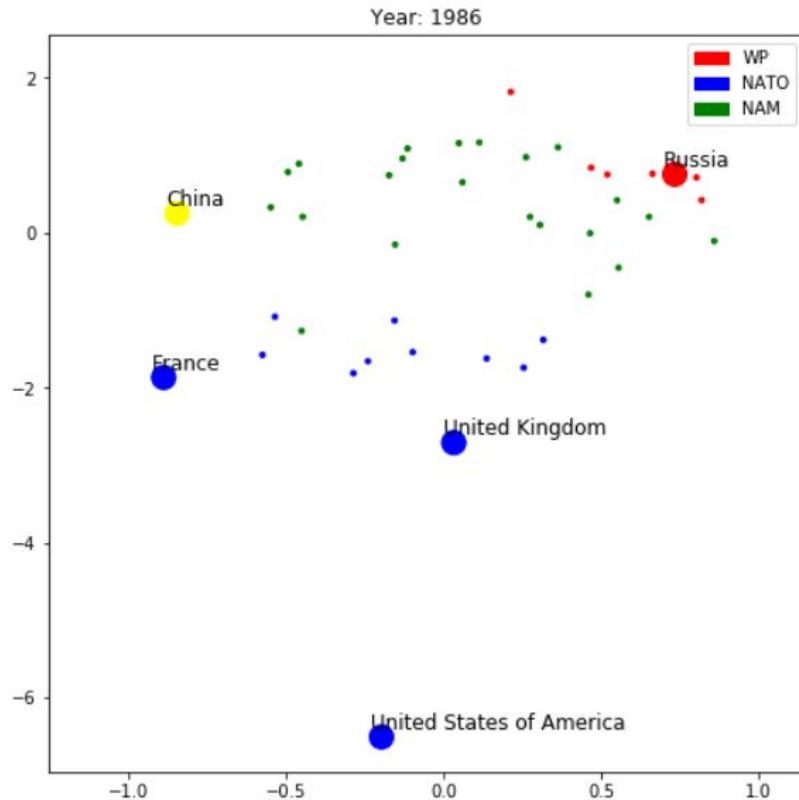


# Before Perestroika

Year: 1985

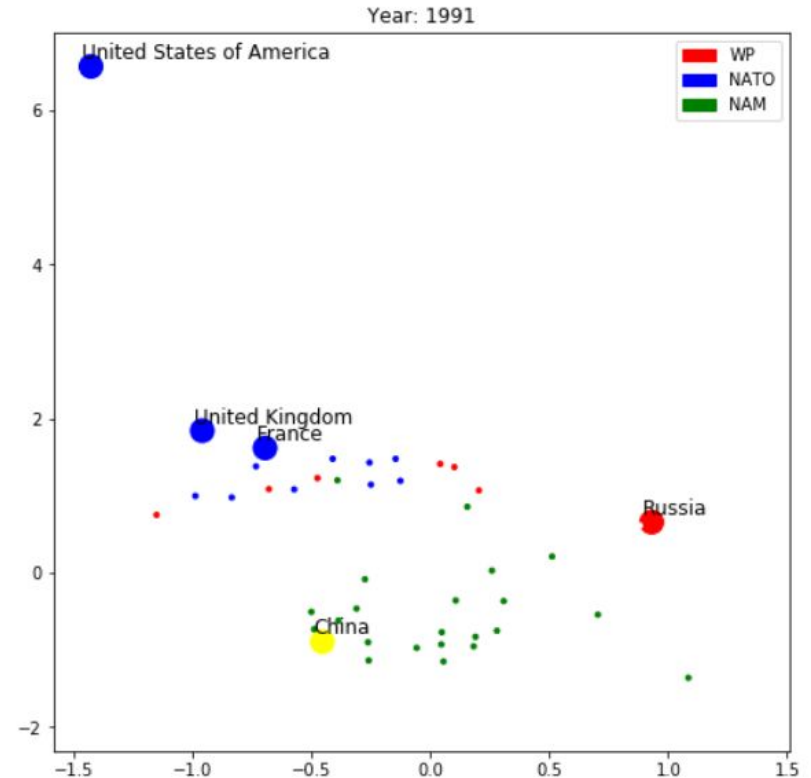


# After Perestroika



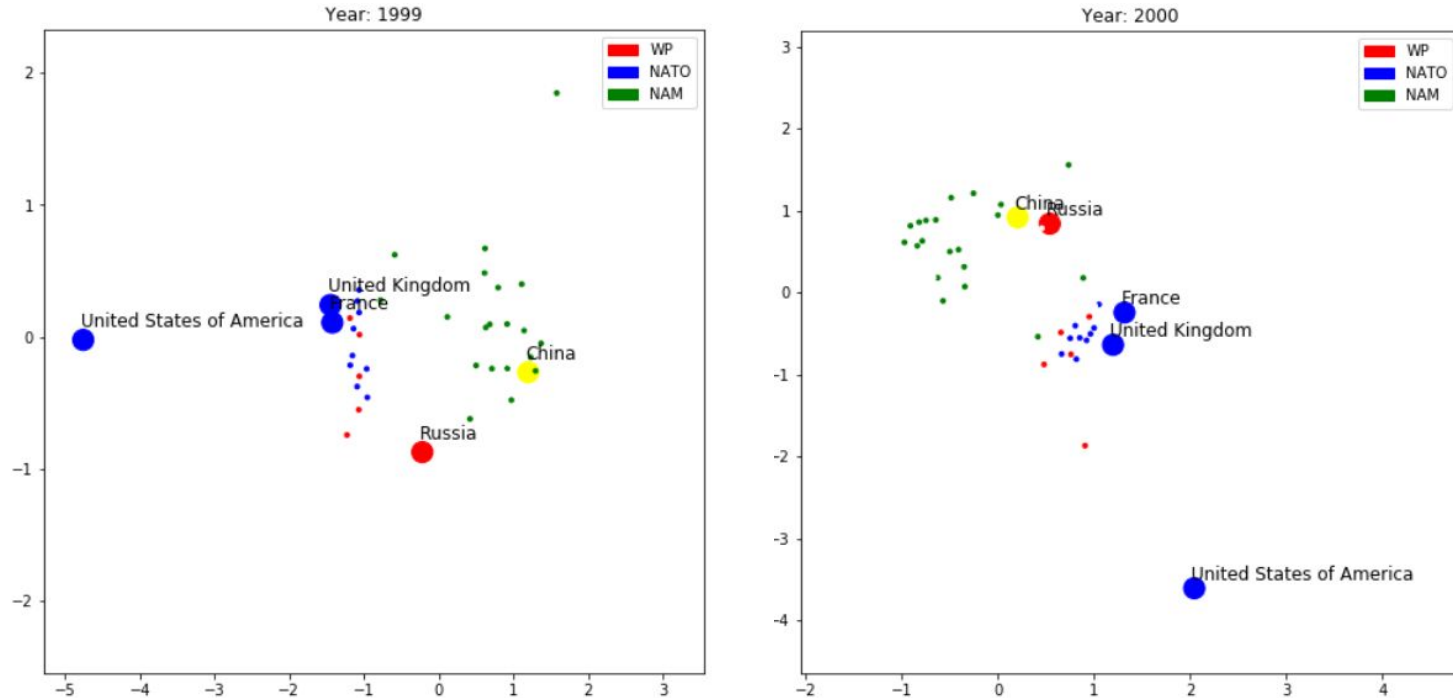
# End of Cold War

USSR lost almost all its Warsaw Pact allies in 1991. At the end of that year, the USSR dissolved.



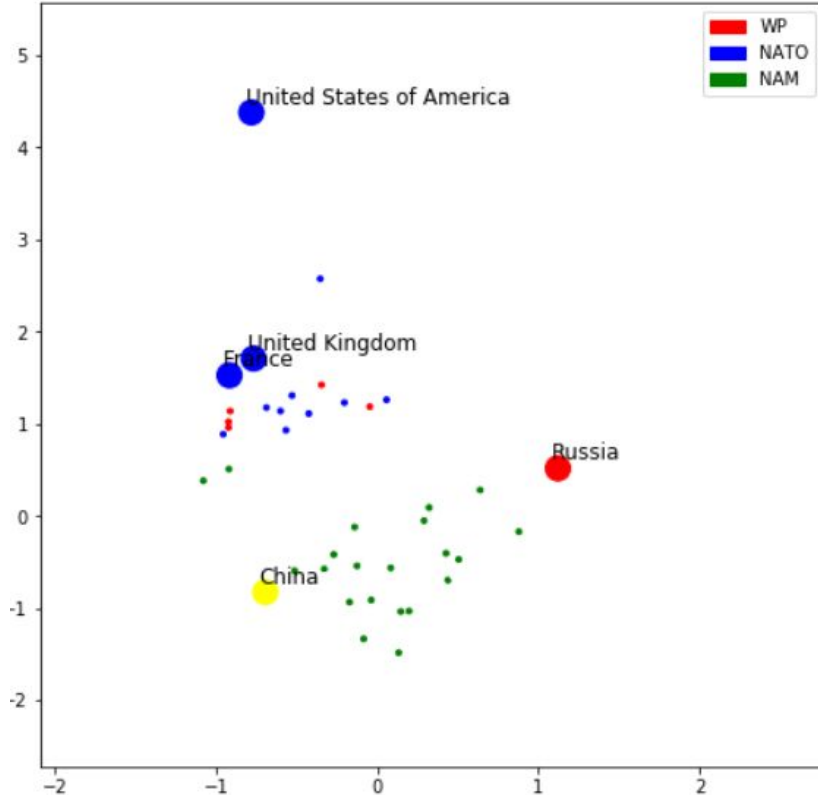
# Putin & Russia

We can see the difference of Russia's position following Putin's election.



# World in 2015

Year: 2015



America, Russia, and China stand out

The fact that the US is distancing itself from the 'herd' could be indicative of the sentiment that led to Trump's election

## Part III - Homophily or social influence?

Another question we care about is whether or not voting patterns in the UN are due to economic similarity.

### Define similarity and link

We used  $\log_2(\text{GDP per capita after PPP adjustment})$  as a similarity metric. When the difference is less than 1, then the two countries living standards are about the same.

We defined the link between two countries when they have an above average affinity score in that year.

# Using Chi2 value to calculate.

X is the similarity and G is the link.

If  $C(x_t, G_{t+1}) > C(x_t, G_t)$  This is homophily.

If  $C(x_{t+1}, G_t) > C(x_t, G_t)$ . This is influence.

# Homophily and influence in each period

Chi2 difference	1960-1990	1990-1991	1991-2015
Homophily	-4.84	10.66	11.56
Influence	-3.19	-0.001	30.91

During the cold war, there are not significant changes in voting patterns, which leads to low homophily and influence scores.

When the USSR was dissolved, the satellite states could more effectively select their political positions which lead to a larger homophily score.

After the cold war, both homophily and influence effects are large.



# Conclusion

UN voting is a good indication of international politics, reflecting countries' power, positions and alliances.

The changes over time are a result of both homophily and social influence, but their influence varies in different historical periods.