

Historical Changes of Alliance Networks among Nations

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The purpose of this paper is to show how the alliance networks among nations changed from 1816 to 2000. By our analysis, it was made clear that the alliance networks lead by the United States since World War II is a small-world network.

1 Introduction

Between countries, there are a lot of interactions; wars, trade, finance, and so on. Among those interactions, it is the national security that is most important one for a nation. In this paper, of all interactions of the national security, the focus will be on security alliance. By defining nation as node, and alliance as edge, it becomes possible to look at international relations as alliance networks. The characteristics of this alliance networks and its historical changes will be clarified through examining historical changes of "clustering coefficient" and "average path length".

Through this analysis, it can be suggested that difference alliances affect each other though they look unrelated at a glance. This suggestion is significant in that it can provide a new model for International Political System.

2 Analysis Objects and Methods

In this paper, network index will be calculated from alliance networks including USA, Britain, Germany, France, Russia, and Japan. By including these nations, most alliance networks can be covered.

The data from "The Correlates of War Project, Formal Data Set" (COW)¹ is used for calculation of alliance network's "clustering coefficient" and "average path length". In COW data, "alliance" is divided into three types: "defense alliance", "neutrality or non-aggression alliance", and "entente". In this paper, two kinds of analysis will

be done. One is for all alliance. The other is for only defense alliance.

3 Analysis Results

Results of analysing all alliance networks are shown from fig.6 to fig.17. The network index of each 6 country (U.S.A, U.K., Germany, France, Russia, Japan) is shown from 6 to 17. The network index which combines all 6 countries is shown on 2 and 3. The results of analysis of defense alliance networks is shown on 4 and 5.

3.1 All Alliance Networks

Judging from 2 and 3, it could be said that the character of alliance networks changed drastically after World War II. Before World War II, the clustering coefficient was, in general, either 0 or 1 and the average path length was 1.

However, after World War II, the alliance networks split into two groups; Western alliance network and Eastern one. These two groups united one when Cold War ended. In Western alliance network, the clustering coefficient gradually increased up about 0.9, though the average path length gradually decreased until Cold War ended. By the reunification with Eastern countries, it increased up to about 2.2.

Considering the fact that clustering coefficient is large and average path length being small, this

¹<http://cow2.la.psu.edu/>. We use "Formal Data Set ver. 3.03" for this analysis.

²For each index's calculation, [1].

³National data for just "defense alliance" is omitted due to paper length.

network of alliance can be said that it is a "small world network". By actually visualising the alliance network of year 2000 with USA as center, as seen on fig.1, it could be seen that it forms a "small-world network".

3.2 Defense Alliance Network

It could be seen from fig.4 and fig.5 that Defense Alliance Network is also changes its characteristics after World War II. Before World War II, in many cases, the clustering coefficient is either 0 or 1 and average path length is 1.

After World War II, the network splits into Western and Eastern alliances. However, unlike all alliance network, it does not unite into one. Eastern alliance network's clustering coefficient declines down to around 0.3 and disappears when Cold War ends. After rising to about 3, average path length decreases to 1.6 and ends as well. For Western alliance network, clustering coefficient gradually increases and converge around 0.9 while average path length decreases and converge around 1.5. Therefore, defense Alliance Network can also be defined as a "small-world network".

3.3 Characteristics of Each Nation

In terms of times before World War II, characteristics of the International political system can be seen from each nation's data. From the fact that there are no data of the U.S.A. before World War I(1914-1918), it could be said that the U.S.A. had no alliance¹. Britain has a data throughout the years, but clustering coefficient tends to be 0, telling us that most alliance was bilateral alliance². On the other hand, Russia, France, and Germany does not often result in 0, meaning most alliances were multilateral alliances.

4 Conclusion

As a result of two analyses, it became clear that the characteristics of alliance network changes drastically after World War II. Especially the network centering the U.S.A. after World War II became clear that it is an "small-world network",

¹It could also be said that they were taking Isolationism policy.

²Sweden, Portugal, and Japan were the alliance partners.

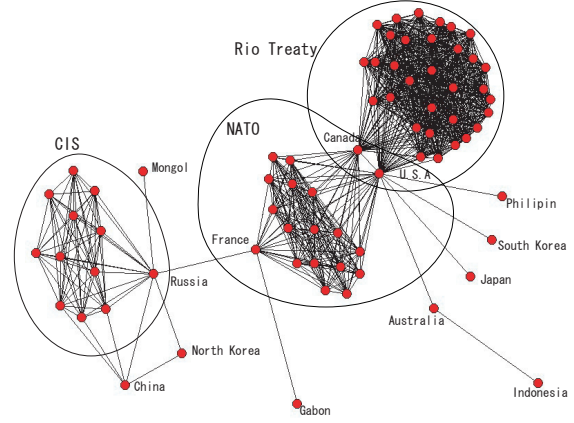


Figure 1: One Alliance Network in 2000 (all)

having large clustering coefficient and small average path length. This is due to the fact that most alliance was bilateral and multilateral alliance barely existed before World War II. Clustering coefficient becomes 0 when bilateral alliance network forms a star.

Also, the characteristics of Western alliance after World War II appeared due to formation of two kinds of network. One being multilateral alliance network like North Atlantic Treaty Organization and The Inter-American Treaty of Reciprocal Assistance, and the other is bilateral alliance network, such as Japan - the U.S.A. Alliance. In case of complete graph, the clustering coefficient and average path length both becomes 1. However, by adding bilateral alliance network, clustering coefficient becomes a little less than 1, and average path length becomes larger than 1 by having the U.S.A. as a mediator.

5 In the End

In this paper, by analyzing alliance networks based on data from COW, characteristics of alliance networks was clarified. For further research, it is necessary to include the idea of "centrality" used in social network theory. Also clarification of evolutionary mechanism of alliance networks is a goal in the future.

Reference

- [1] Albert-László Barabási and Réka Albert. Statistical mechanics of complex networks. *REVIEWS OF MODERN PHYSICS*, (74):47–97, 2002.

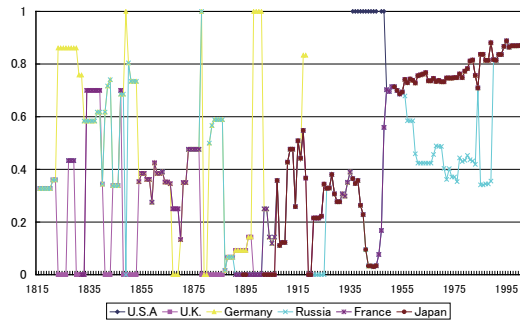


Figure 2: Clustering Coefficient (all)

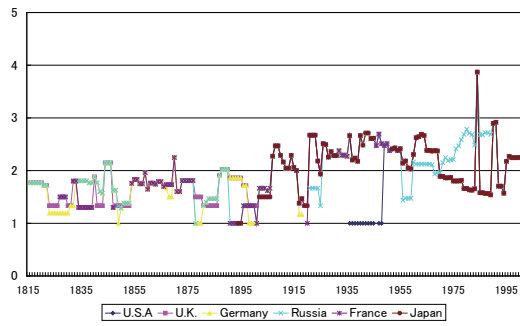


Figure 3: Average Path Length (all)

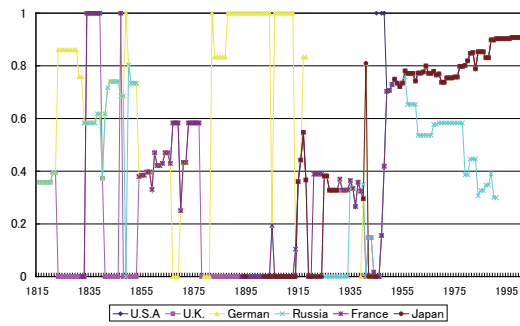


Figure 4: Clustering Coefficient (defense)

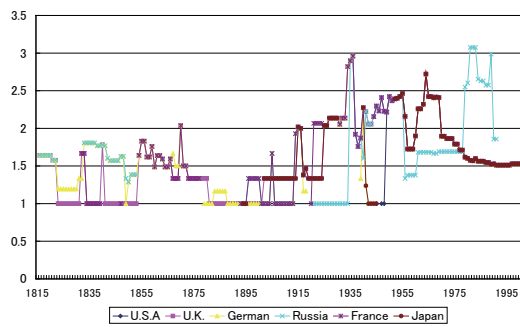


Figure 5: Clustering Coefficient (defense)

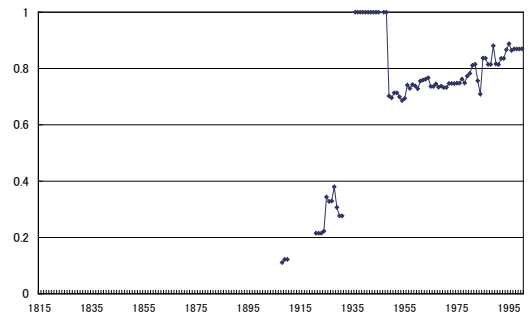


Figure 6: Clustering Coefficient of U.S.A

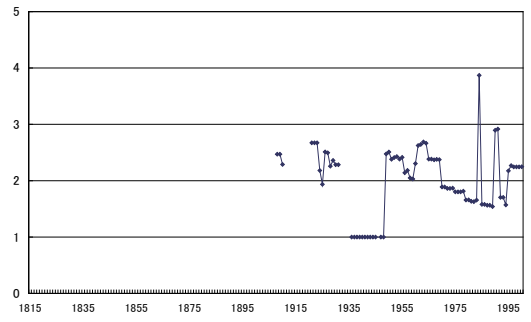


Figure 7: Average Path Length of U.S.A

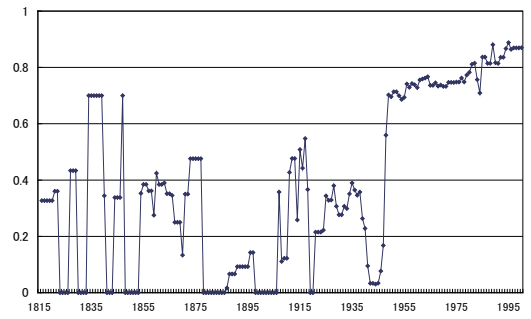


Figure 8: Clustering Coefficient of U.K.

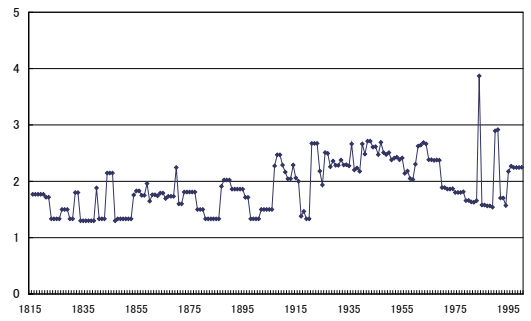


Figure 9: Average Path Length of U.K.

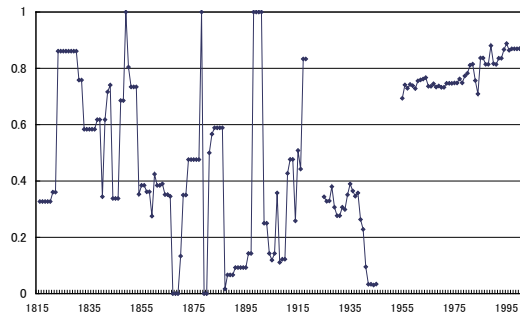


Figure 10: Clustering Coefficient of Germany

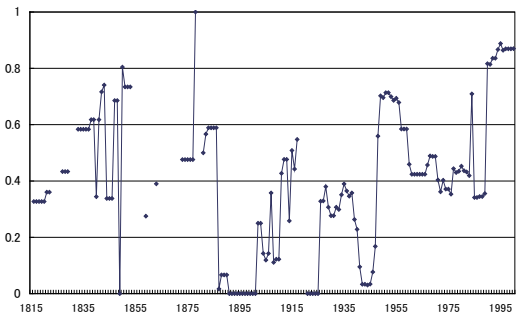


Figure 14: Clustering Coefficient of Russia

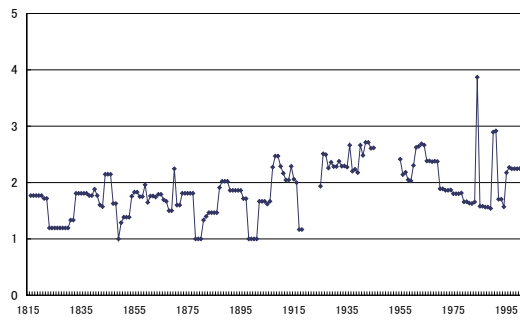


Figure 11: Average Path Length of Germany

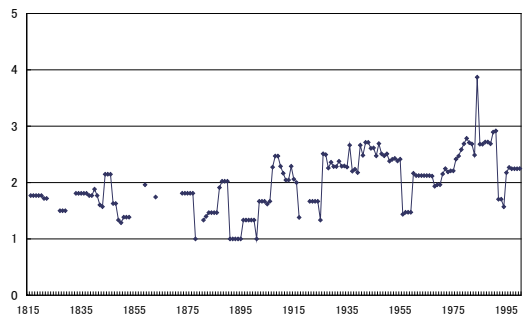


Figure 15: Average Path Length of Russia

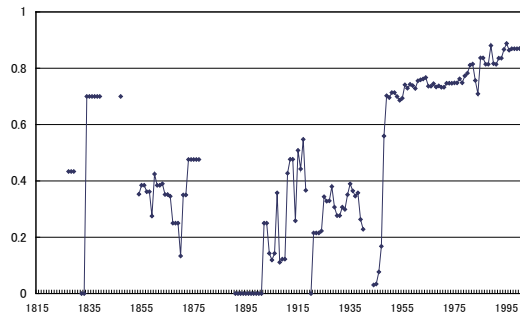


Figure 12: Clustering Coefficient of France

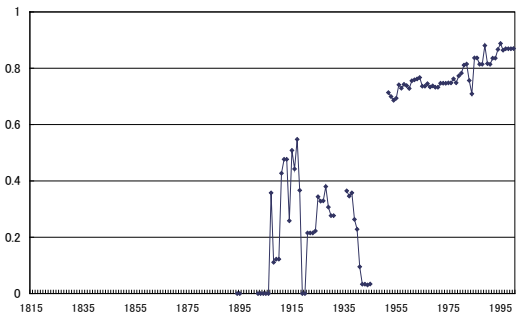


Figure 16: Clustering Coefficient of Japan

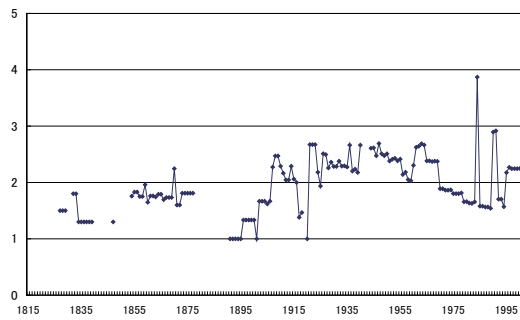


Figure 13: Average Path Length of France

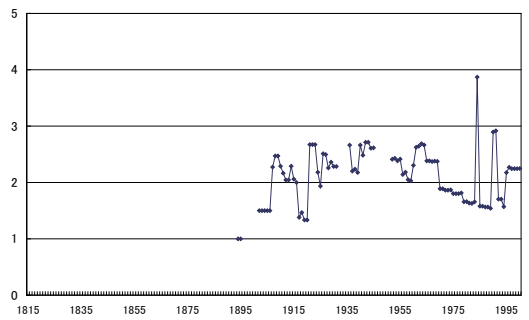


Figure 17: Average Path Length of Japan