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A Network Analysis for the Conformation of Public Opinion

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[Key words]

The Conformation of Public Opinion, Network Analysis, The Average of Shortest Path, The Number of Cluster

1. Introduction

In our previous study [Murakami & Tanida (2008)], we examined how people's distrust in public pension system and its propagation will effect on Japanese public pension system. For the sake of clarifying the relationships between them, we created our model with care and attention for economical, sociological and network theoretical points. In that case, we treated the propagation of people's distrust in public pension system as the conformation of public opinion, and created a model using DSIT (Dynamic Social Impact Theory) and BA (Barabasi-Albert) model. As a result, we had a conclusion that people's distrust in public pension system and the propagation of distrust has a decisive influence on the pension premium fund.

However, to consider complex array of factors involved in the result remained as a matter to be discussed further. Therefore, in this study, we devote some space to the discussion about the feature of agents' network. As the first step of our analysis, we will examine how agents are related with "the average of shortest path" and "the number of cluster." Of course, until now, many indices that characterize network are developed (e.g. betweenness, closeness, centrality, clustering coefficient, k-core, m-core, n-clique) Among them, these two indices are perceived to the basic indices for characterizing network. Then, we will analyze the relationships between them and the process of conforming of public opinion.

2. The Structure of our Model

In this section, we will provide a simple explanation about our model.[1] We link each agent for expressing people relationships using BA model.

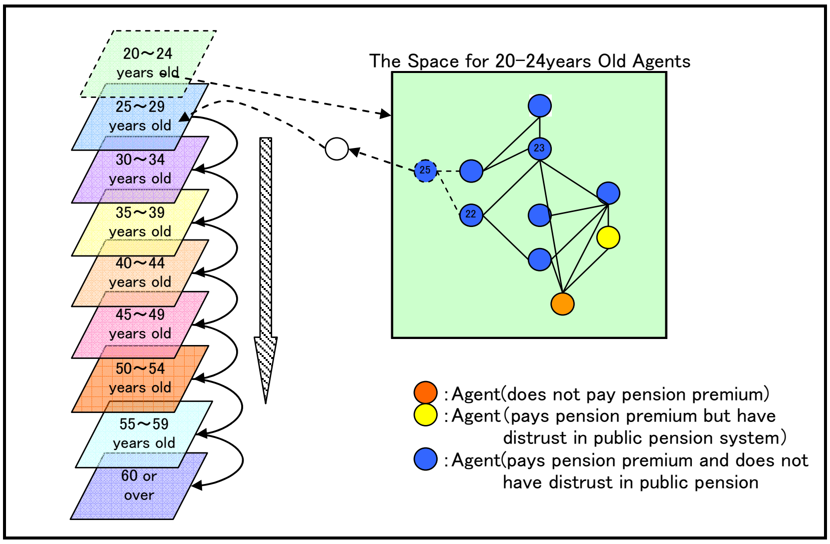

Figure 1 The Image of our New Model

[1] See Murakami & Tanida (2008) for detail.

It is said that people's relationship in real world can be expressed as small world phenomenon. In addition, the scale freeness of people's relationship in real world, that is, some people have a large circle of acquaintances but many people have a limited circle of them is confirmed (e.g. some research using the data from social networking service, Hayashi(2007b)).[2] For these reasons, we do not link each agent randomly. In stead, we link each agent using BA model. We have reached that BA model, which have a feature of (i) network expand continuously by the addition of new vertices and (ii) new vertices attach preferentially to sites that are already well connected, might play an appropriate role in linking agents.

At the same time, we divide agents into 9 age groups in consideration of "the strength of each relationship among agents" and put them on each age group's space. In each space, agent put a link to the other agent who has a slight difference in age. For example, when an agent who has linkage to the other agent at the "space for 20-24 years old agents" reaches 25 years of age, he (or she) moves to the "space for 25-29 years old agents" and forms new network. The image of our model appears in Figure 1.

In addition to stated above, we make each agent have "attitude score," which is quantified the degree of subjective opinion about Japanese public pension system, by reference to DSIT model, especially Morio (2003) model. Each agent's attitude score is changed with the interaction between agents who have linage to each other. In addition, they make a decision about whether or not to pay pension premium (if people have distrust in public pension system, they should give up paying pension premium.).

3. Analyze the Conformation of Public Opinion by Network Indices

3-1. Summary of Simulation Result

In this section, as stated above, firstly, we will examine how agents are related with the average of shortest path and the number of cluster. Secondary, we will analyze the relationships between them and the process of conforming of public opinion.

In the simulation, data were gathered over 700 turns (steps). From simulation's start to 700 steps, agents are born and died like humans. Moreover, agents form "new link" with the other agents, as they get older. The average of shortest path in each space and the number of cluster were gathered every 59 steps. We should gather data in every step but we did not so. Because of limitation of computational power, it is difficult to gather the data step after step. The data should be gathered at certain interval. An appropriate length of interval is 60 steps. However, many agents re-form their link every 12 steps. At the process of re-forming agents' link, some links among agents are temporarily disappeared and the number of cluster is very low. Therefore, we gather the data every 59 step in consideration of eliminating these factors. First of all, we will show the result from these

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2 The degree distribution obeys power law.

data in Table1 and Figure 2.

We see from Table1 and Figure2 that the number of cluster and the average of shortest path indicate a similar tendency in the latter half the simulation. In other words, in the latter half of the simulation, the average of shortest path among agents is shifted in proportion to the number of cluster. However, as shown in Figure2, there are a few exceptions, for example, 177th, 295th step. In these two steps, the number of cluster is greatly decreased. It is because many agents re-form their link every 12 steps, in our model. The number of cluster varies greatly depending on how agents re-form their link. With the view to such reasons, we will calculate moving average in two indices respectively, and use them for analyzing relationships among the number of cluster, the average of shortest path and the conformation of public opinion.

Table 1 The Summary of Simulation Result

	59th step	118th step	177th step	236th step	295th step	354th step	413th step	472nd step	531st step	590th step	649th step
The Number of Cluster	96	197	54	126	73	92	88	91	173	160	12
The average of shortest path length in each space											
20-24 space	2.097561	3.551724	3.500000	3.566667	3.620690	3.480000	3.680000	3.304348	3.440000	3.208333	3.080000
25-29 space	3.875000	1.487805	3.966667	3.933333	3.700000	3.714286	4.000000	3.880000	3.840000	3.708333	2.960000
30-34 space	4.023256	4.031250	1.595238	3.766667	3.933333	3.866667	3.750000	3.760000	3.636364	3.708333	3.200000
35-39 space	3.826087	4.119048	4.156250	1.476190	4.241379	3.689655	4.066667	3.758621	3.800000	3.583333	3.240000
40-44 space	3.921053	3.595745	4.023256	3.741935	1.333333	4.033333	3.793103	3.900000	3.962963	4.250000	3.400000
45-49 space	4.100000	3.861111	4.000000	3.809524	3.687500	1.642857	4.100000	3.666667	3.766667	3.758621	2.880000
50-54 space	4.325000	4.025000	4.026316	4.130435	4.317073	4.093750	1.523810	3.931034	3.689655	3.689655	2.896552
55-59 space	4.204082	3.868421	4.275000	4.081081	3.956522	3.953488	4.187500	1.642857	4.233333	4.000000	3.433333
Average	3.796505	3.567513	3.692841	3.563229	3.598729	3.559255	3.637635	3.480441	3.796123	3.738326	3.136236

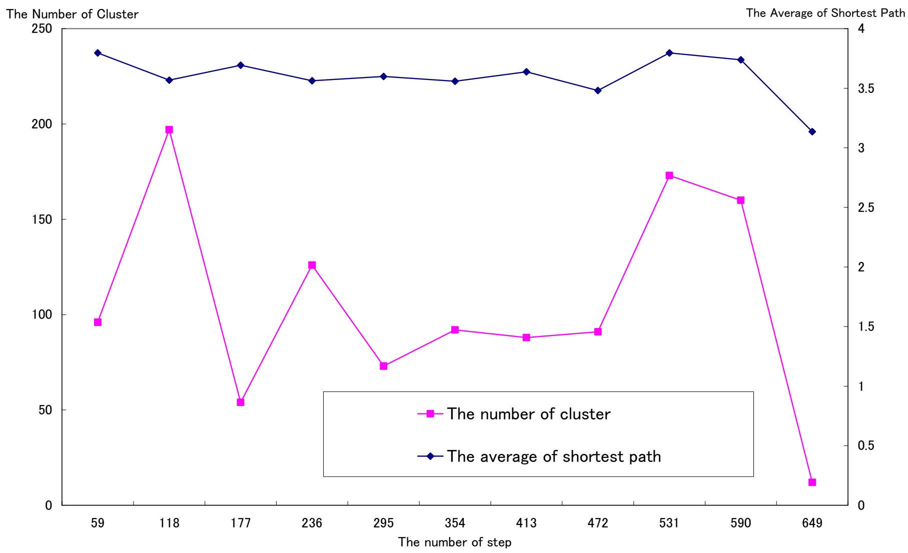

Figure 2 The Summary of Simulation Result

3-2. Network Analysis

The moving average of the number of cluster, that of the average of shortest path, and the number of agent who have distrust in public pension system are shown in Figure 3.

As shown in Figure3, two indices' moving average and the number of agent who has distrust indicate a similar tendency. The number of agent who has distrust is increased in case that the number of cluster and the average of shortest path go up. It is inferred from these results that a decrease in the number of cluster lead to increase majority's (agent who do not have distrust) influence. It would be better to say that the increase in the number of cluster lead to the growing influence of minority's (agent who have distrust) because the number of minority-to-minority link also increase. Of course, the increase in the number of cluster leads to increase the average of shortest path.

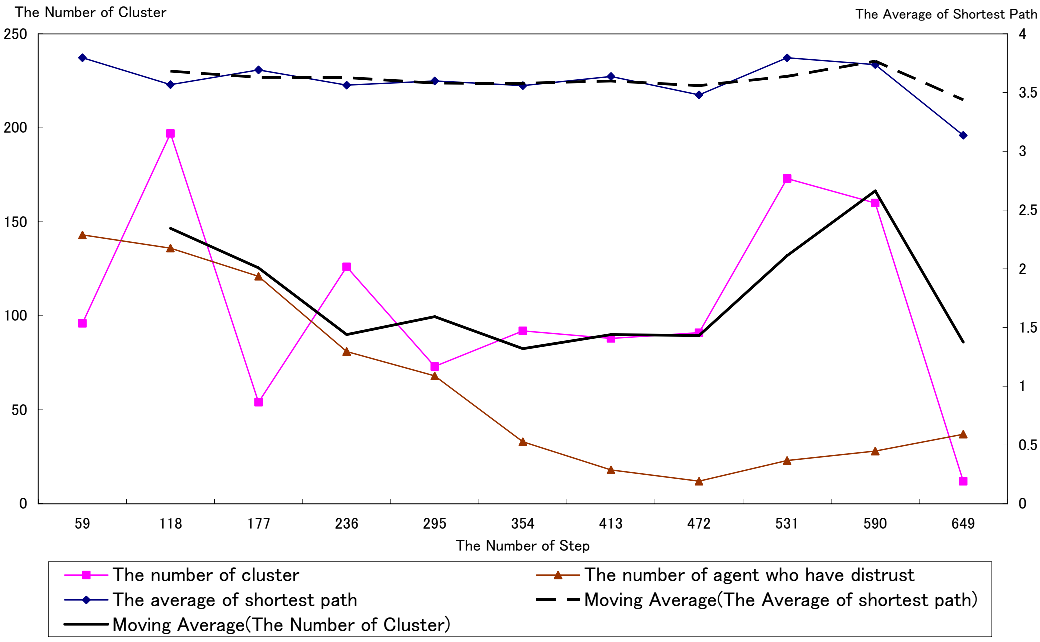

Figure 3 The Comparison of Two Network Indices with the Number of Agent Who Have Distrust

4. Summary and Future work

We will summarize the points so far. It was found from the result in this study that there are some correlations between two network indices (the number of cluster and the average of shortest path) and the number of agent who have distrust. Therefore, we should analyze them in more detail.

For that purpose, it is needed to add the other network indices (e.g. closeness, centrality, clustering coefficient, k-core, m-core, n-clique, specifying "Hub agent" and their opinion) and analyze the relationship between the feature of agents' network and the process of conforming of public opinion by using their indices.

In addition, it is needed to confirm whether our model qualifies for a common feature of network (people's relationship) in real world, that is, scale freeness, small world phenomenon, and a high clustering coefficient. In more detail, it is whether the degree distribution obeys power law, whether the average of shortest path is small, and whether the clustering coefficient is high. Until now, we have calculated all indices except the clustering coefficient. Thus, we have confirmed that the degree distribution obeys power law and the average of shortest path is small in our model.

If the clustering coefficient calculated from our model is small, we should have second thought about how agents are related. We will advance our own research, including the research to some points as state above, by Winter WEHIA08.

Acknowledgement

We appreciate KOZO KEIKAKU ENGINEERING Inc. for providing Multi Agent Simulator (named "artisoc").

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