The Artificial Politician Society: modeling an assembly in silico
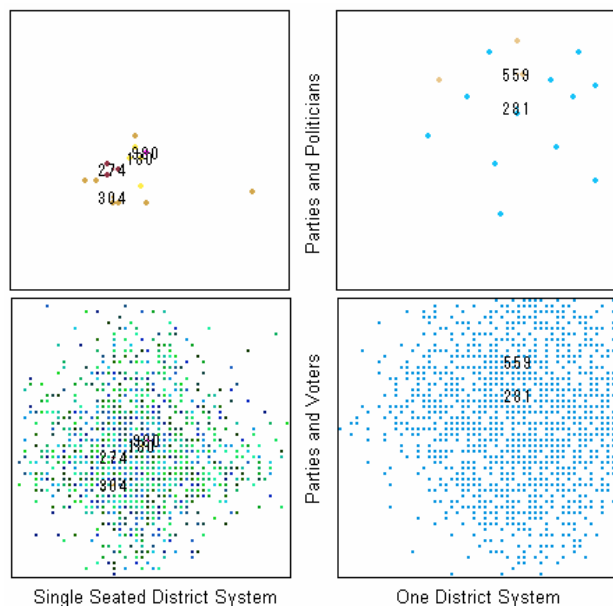
MITSUTSUJI, Katsuma

要約

KK-MAS を用いて選挙の動態過程を表現した「人工国会モデル（The Artificial Political Society）」を構築した。「人工国会モデル」は、選挙民、政治家、政党の三種類のエージェントで構成される。全てのエージェントは、自分自身の政治的な選好を持っている。それぞれの政治的選好は、政治空間（Opinion Space）と名づけられた二次元空間の中の座標で表される。「人工国会モデル」の中では、選挙民は選挙を通じて政治家を選び、政治家は政党を結成する。政党は、選挙民の政治的選好に影響を与える。

　「人工国会モデル」は、簡潔なルールで、選挙民、政治家、政党の政治的選好の動態をモデル化している。選挙を繰り返すことで、より多くの選挙民の支持を獲得できる政治家が生き残り、政治家により近い政治的選好を持つ政党が形成される。政党は、選挙民の政治的選好を引きつける。

　本稿では、基本の「人工国会モデル」に選挙制度を導入している。異なる選挙制度のもとで、選挙民、政治家、政党の振る舞いにどういう差異が生じるかを検討した。「人工国会モデル」の中では、選挙制度によって形成される政党の数が影響を受けることはなかった。その一方で、政治家の持つ政治的選好は、決定的な影響を受けた。小選挙区制度のもとでは、政治家同士の政治的選好は急速に似通うようになり、所属する政党の政治的選好に非常に類似した選好を持つ政治家のみで議会は構成されるようになった。それに対し、大選挙区制度のもとでは、政治家たちの政治的選好はある程度の広がりを持つように分布し、必ずしも政党の選好に近接しなかった。

The Artificial Political Society: voters, politicians and parties in silico[1]

MITSUTSUJI, Katsuma[2]

Introduction

Today we use various representative institutions (e.g. parliament, congress or diet) as decision-making procedures. We select our representatives from the candidates through elections, our representatives build their parties and the interaction of the parties decides or influences the government's policy. Representative institutions exist not only at national level but at local level. In this paper I use the word "assembly" to express the representative institutions of different levels for political decision-making.

The Artificial Political Society Model simulates the dynamics among voters, politicians and parties briefly and abstractly. We can find various kinds of assemblies in each country and even in a particular society there exist various kinds of assemblies. Some assemblies have single-seat electoral district system, others have medium constituency system and still others have proportional representative system. Some assemblies have the authority to choose the chief of the government and others do not. All assemblies, however, have common function to collect and organize voters' political opinions into one collective opinion. The dynamics among voters, politicians and parties give birth to society's collective will. The model focuses on this dynamics.

1. Rules

1.1 Opinion Space and Agents

First, I provide the Opinion Space (two dimensional, 50*50) as a field to show all agents' political opinions. **[Fig. 1]** The coordinates of agents in the Opinion Space show their political preferences. In this paper I temporarily use x-axis to show agents' preferences for Right or Left wing policies and y-axis to show agents' preferences for city-oriented or country-oriented

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[1] First version of the model was submitted to the MAS competition held by KOZO KEIKAKU ENGINNERING. To create the model, I use Multi Agent Simulator (KOZO KEIKAKU ENGINNERING <http://www2.kke.co.jp/mas_e/MASCommunity1.html>)

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policies. Agents positioned to the right side prefer Right-wing policies. Agents positioned to the lower side prefer country-oriented policies. Agents at the upper and right corner prefer Right-wing and city-oriented policy. Agents around the center of the Opinion Space prefer moderate policy and agents positioned close have similar policy preferences.

Second, I provide three kinds of agents for this model --- voters, politicians and parties. The model contains hundreds or thousands of voters, tens of politicians and a few parties. All agents have their own policy preferences and their coordinates in the Opinion Space show their preferences. Next, I will explain the rules among three kinds of agents.

1.2 Rule: Voters and Politicians

In the Artificial Political Society there exist hundreds or thousands of voters and tens of politicians. All of them have their own preferences and at the beginning their preferences are given at random. **[Fig. 2]**

Voters select politicians through elections. The elections take place every 50 steps. When the election starts, there emerge new candidates two times as many as assembly's seats. When the assembly has 15 seats, there emerge 30 new candidates. There already exist 15 incumbent politicians. Forty-five candidates, old and new, contest for 15 seats in the election.

In the election every voter polls for a candidate who is positioned closest to him/her. As written later, electoral systems may restrict candidates whom voters can poll for. Candidates who get enough votes in the election can get seats in the assembly. Every 50 steps politicians are screened and selected by voters. Since politicians who have preferences close to voters' survive in the election, politicians' preferences get closer and closer to voters'.

1.3 Rule: politicians and parties

Next I will explain rules between politicians and parties. **[Fig. 3]** In each step politicians who do not belong to any party may join existent parties. The probability that a politician joins a particular party is decided by how long the distance between them is and how sticky the assembly's political culture is. The long distance between a politician and a party means they do not have similar political opinions and the politician is unlikely to join the party. The stickiness means how troublesome it is for politicians to change their party memberships in the assembly. Some assemblies have strong stickiness and politicians need much energy to change their party memberships, economically or politically. The probability that a politician i

join a party j at every step is

$$P(Jij) = 1 - Dij * St$$

Jij: Phenomenon that politician i joins party j.

Dij: Distance between politician i and party j. Distances in the model are always expressed by the ratio to the length of diagonal line of the Opinion Space.

St: The stickiness of the assembly's political culture. 0<St<1

In each step the politicians who belong to parties that has remote preferences from their own may leave the party. The probability that a politician withdraws from a party is also decided by distance and stickiness. When they position distantly, the politician is likely to withdraw from the party. When the assembly's political culture is sticky, politicians can not change their party memberships easily, even if their positions are far. The probability that a politician i join a party j at every step is

$$P(Wij) = Dij * (1 - St)$$

Wij: Phenomenon that politician i withdraw from party j

Dij: Distance between politician i and party j.

St: The stickiness of the assembly's political culture. 0<St<1

Politicians who do not have any party that can satisfy him can try to establish a new party whose preference is similar to his/hers. The level of easiness for politicians to form a new party varies among various assemblies. In the Artificial Political Society the easiness is described as a probability that a politician who belongs to no party form a new party.

$$P(Fi) = F$$

Fi: Phenomenon that politician i form a new party.

F: The easiness to build a new party. 0<F<1.

As a result most of the politicians in the model belong to some party. Most of them belong to parties which have similar preference with their preferences. Occasionally a politician belongs to a party that has a remote preference from his own and there exist another party which has a closer preference to his. Some steps later he will probably change his party membership.

The party's preference itself is decided by its members' preferences. At the beginning the party's preference is exactly the same as its builder's preference. In each step the party meets the politicians who belong to it and adjust its preference to position in the middle of all its

members.

1.4 Rule: parties and voters

So far I explain rules between voters and politicians and between politicians and parties. Now I will illustrate rules between parties and voters. **[Fig. 4]** Party's political opinions are focused and propagated on mass media everyday and then it is natural to think that the parties exert influence upon voters' political opinion little by little.

Every 10 steps parties can attract voters' preferences to its own preference. Steps by steps voters' preferences come closer to the parties' preferences. However, parties' influence does not work evenly. Larger parties have greater influence than smaller parties. Parties are unlikely to have their influence upon voters who have very different preferences. Political culture that each assembly has may have some significance. In some assemblies voters may be influenced more strongly than in other assemblies. The probability that the voters are influenced by the parties is

$$P(Iij) = \frac{Si * A}{Dij}$$

Iij: Phenomenon that party i exert influence and attract voter j.
Si: The proportion of party i's seats to assembly's all seats.
A: The tendency voters general are influenced by party's opinion. 0<A<1
Dij: Distance between party i and voter j

In each step voters change and move their preferences at random independently of the procedures above. Voters may change their opinions for themselves or other social agents may influence their opinions. This random movement decides voters' many kinds of behaviors that this model does not contain.

1.5 Dual Dynamics

The Artificial Political Society Model consists of simple rules among three kinds of agents --- voters, politicians and parties. How do they behave when these rules run at one time? Voters choose politicians who have close preferences through elections. Politicians attract parties' preferences and otherwise try to establish a party that has closer preference. Parties attract

voters' preferences.

There seems to emerge two kinds of movements --- centripetal and centrifugal. The preferences of three kinds of agents tend to come closer and closer. Steps by steps there emerge big swarms of voters centered around a party. This does not mean, however, only one big party survive. Politicians' behavioral pattern does influence the parties' preferences strongly and the position of parties influence voters' behavioral pattern strongly, too. The interaction and incident among politicians might cause voters' divisional movement. Occasionally politicians' splits cause division and change in parties' opinions. This may dissolve a voters' swarm.

2. Electoral System

2.1 Electoral System in the Artificial Political Society

Now electoral system is introduced into the model. Basically, as written above, voters can poll for any candidates who have closest opinions. This rule simulates the situation where there exists only one electoral district. As all candidates and voters compose one electoral district, candidates who get enough voters' supports win simply their seats.

By dividing voters and candidates into electoral districts, we can introduce electoral system into the Artificial Political Society. When there exist 15 seats in the assembly, we can divide the seats into 5 districts, for example. All voters and candidates are divided into 5 districts and in each district the candidates fight for 3 seats and voters choose poll from candidates who belong to their own district. When we divide voters and candidates into 15 districts, we can simulate the single-seat electoral district system. All voters and candidates are divided into 15 districts and each district has only one seat. In each district candidates compete for one seat.

Electoral systems are said to have significant impact on the behavior of politicians and parties. Using the Artificial Political Society model, we can gain insights about what effect the difference of electoral systems brings about. In the next section I'd like to compare the one district system, the medium constituency system and the single-seat electoral district system. The one district system has only one electoral district and the district has all 15 seats. The medium district system has 5 districts and each district has 3 seats. The single-seat electoral district system has 15 districts and each district has only one seat.

When all the other parameters are set in the same condition, what differences will each electoral system brings about? As mentioned in the rule section, there exist many parameters

that effect agents' behavior. The difficulties for politicians to change their party memberships (St), the easiness for politicians to form new parties (F) and the tendency that voters are influenced by parties' opinions (I) are assumed to effect agents' behavior. When these parameters are fixed and only electoral system is altered, we can gain insights about what is the impact of electoral system on political system.

2.2 Results

First, the electoral system is assumed to effect number of parties. As mentioned by Duberger in his classical work [1954], does the single-seated electoral district system generate two party system in the Artificial Political Society, too? Table 1 shows the average number of parties on various conditions. The table 1 shows that electoral system in the Artificial Society does not have real significant impact on the number of parties. Indeed other factors, such as easiness for politicians to change their party membership or easiness to form new parties, have more significant impact on the number of parties. When politicians can change their membership easily, number of political parties decreases obviously. The difference of electoral system seems not to have decreased nor increased number of political parties.

One important abstraction in the Artificial Political Society is that no agents have strategic thinking. Voters simply poll for candidates who have close opinions and politicians form parties that have close opinions. One of the reasons that the single-seated electoral system does not lead to two party system is lack of strategic thinking. Oppositely if electoral systems lead to some types of party system, agents' strategic thinking might be an essential factor.

Second, when we convert electoral system, the distribution of politicians' opinions changes drastically. Figure 5 shows typical distribution of politicians' opinions when single seated electoral district system or one district system is adopted. The single seated system generates very dense groups of politicians. They have to fight for only one seat in each district and therefore the only politicians who can seize the center of voters' opinions survive in the elections. All politicians come closer and closer to the center of voters' swarm rapidly. In other electoral systems, politicians who are not positioned at the center of voters can survive by taking the second place or the third place in the elections. The distribution of politicians spread over the swarm of voters and their opinions vary to some extent.

Conclusion

The Artificial Political Society Model describes very limited aspects of political phenomena that take place around the assembly. Many things are neglected. No mass media, no abstention, no bribes and no strategic behaviors. All agents behave according to their opinions or preferences. Obviously the model is too abstract to use for predictive purpose.

The model, however, shows the dynamics among voters, politicians and parties very well. They all move dependently from each other but there always exist lags among them. Anthony Down's classical model describes the relationship between voters' preferences and parties' policies boldly and simply [Downs 1957]. Down's model gave political scientists many hints and insights to understand parties' behavior. The Artificial Political Society Model has very similar structure with Down's model and will be a good tool to understand behavior of both political parties and politicians. While Down's model has basically a very static nature, the Artificial Political Society Model is very dynamic. Using this model with good assumptions, we might gain some insights for party systems' changing nature.

The tests using the Artificial Political Society show electoral system may not have significant impact on the party system but change the distribution of politicians' opinions drastically. Under single seated electoral district system politicians have very close opinions and their opinions are very close to their parties' opinions, too. On the other hand, under the one district system politicians have diversified political opinions to some extent and their opinions are not always close to their parties' opinions. **[Fig 5]**

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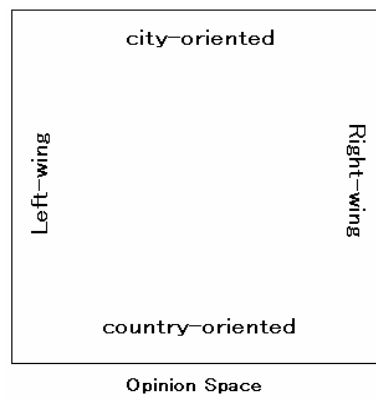
Figures

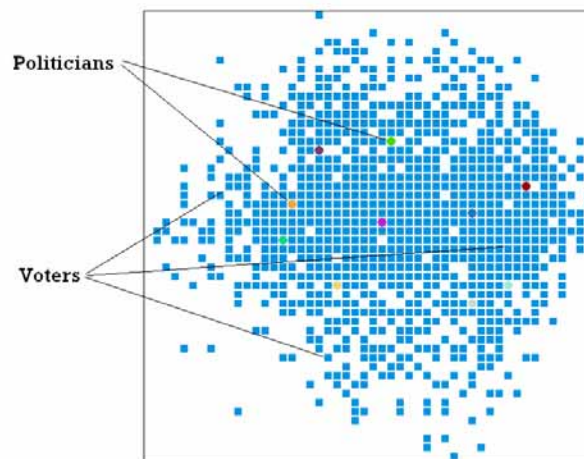
Fig.1. An example of the opinion space
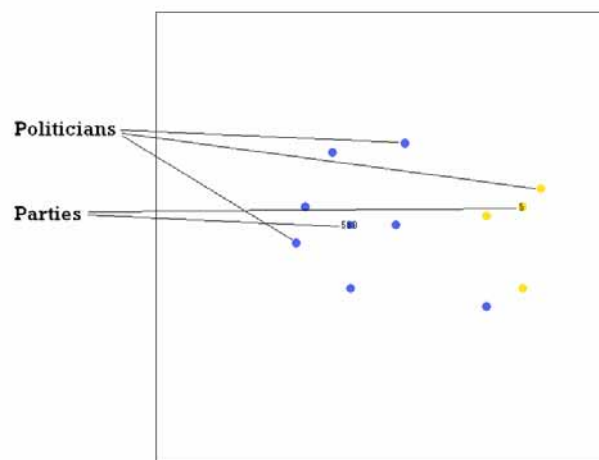

Fig.2. Politicians and voters in opinion space
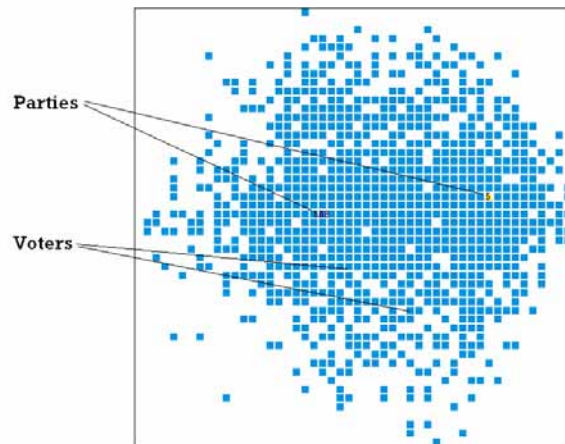

Fig. 3. Politicians and parties in opinion space

Fig.4. Parties and voters in opinion space

* Voter 1000, Seats 15, 10 times Elections
* S = single seated electoral district system (15 seats/ 15districts)
* M = medium district system (15 seats/ 5 districts)
* P = one didtrict system (15 seats/ 1 district)

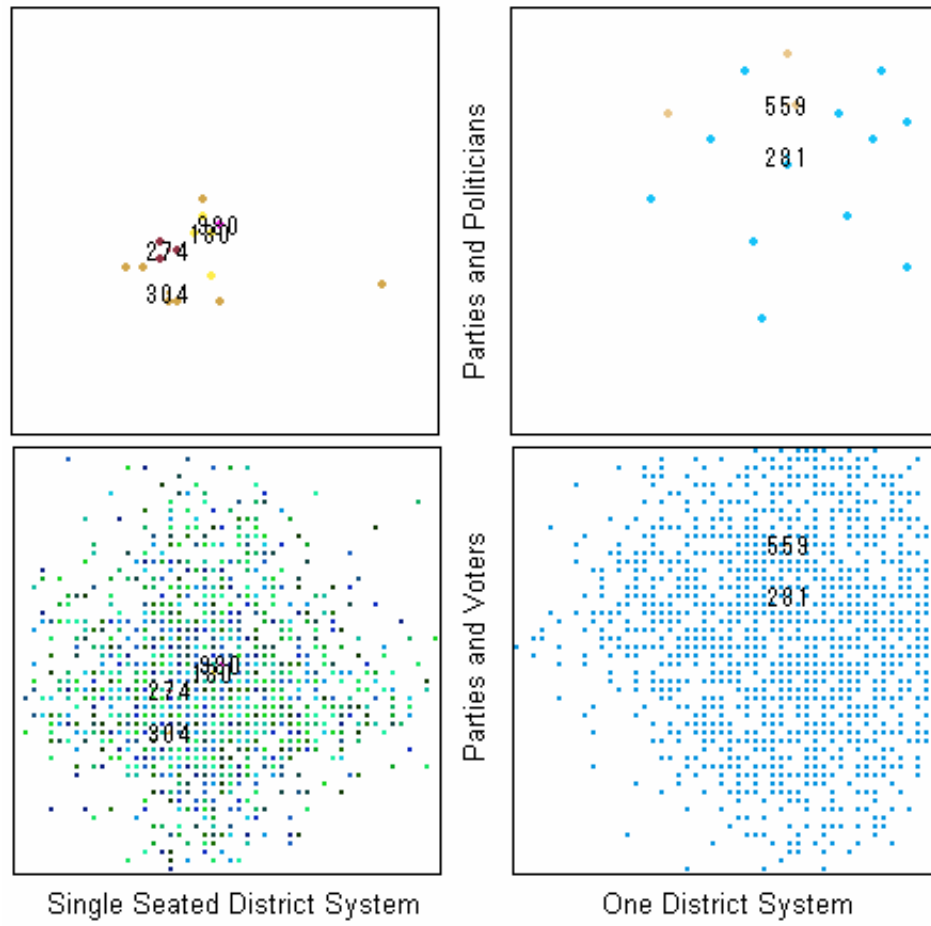**Table.1.** Average Number of Political Parties on various conditions

Fig.5. Single Seated District System and One District System

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