An Experimental Pilot: Gerrymandering

By: Sun Ah (Sunah) An , Michael Anderson , and Steve Dannemiller

Motivation

Gerrymandering involves the strategic drawing of districts in order to provide a political candidate with an advantage. When choosing where and how to campaign, candidates consider the composition of voting districts. If a district is normally won by a democrat, for instance, a republican politician may not want to campaign in that area at all and simply save their resources for districts in which they have a greater likelihood of winning. Thus, when a political party is able to draw the voting districts they possess the ability to alter the likelihood of their party's candidate winning, which is gerrymandering.

With this in mind, we wanted to investigate three main questions. (1) How do candidates compete on a particular election map relative to theoretical predictions, (2) When candidates are incumbents do they choose election maps that are personally advantageous, and (3) When candidates do not know whether they are the incumbent or the challenger do they pick more "fair" election maps. Though our investigation is limited by computational challenges regarding various map "designs", answering the above questions provide insight on how candidates might direct resources during campaigns, whether they participate in gerrymandering, and what they view as a fair drawing of the districts.

Literature Review

There is a robust literature on political spending in experimental economics. Congleton (1986) examined how political campaigns spending to target undecided voters behave. They found higher rent-seeking losses where spending impacts an undecided group of voters. Konrad

(2007) discusses how campaign budgets for advertising are critically important in determining election results. Particularly, Coate (2001) focuses on the power of moderates in determining elections using a theoretical model. While other research in this area has focused on rational ignorance, ideological conviction, and communication, no research we noted used Tullock style models to examine the impact of gerrymandering on political spending (Congleton 1991; Congleton 2001; Leibbrand and Sääksvuori 2012). We attempt to extend this field by examining the impact of gerrymandering on political spending in Tullock style contests.

It is important to note that there is a model for how gerrymandering may occur in a Colonel Blotto style game (Washburn 2013). This paper discusses how different relaxations of the Blotto game can be utilized in order to examine how drawing districts can impact who wins the game. This study does not however run any experiments testing the model.

There also is research on the impact of a veil of ignorance on decision making in political contests (Congleton and Sweetser 1992). They find that the lack of a veil of ignorance increases political deadlock and that a veil of ignorance could alleviate some of this issue. Congleton (2001) similarly finds that ignorance may stabilize policy outcomes by preventing political deadlock. We intend to extend this literature by seeing how placing competitors behind a veil of ignorance impacts the makeup of districts they wish to compete in.

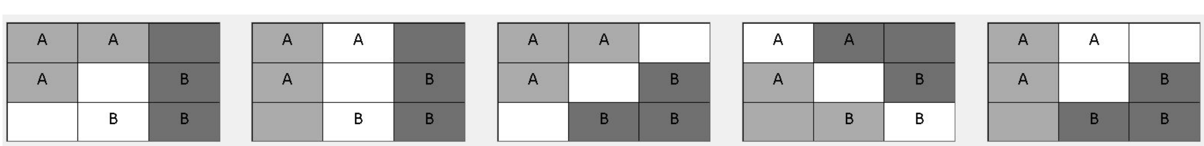
Experimental Design

We ran a pilot which had 8 subjects, all of whom were recruited from the undergraduate student population of The University of Alabama. To prepare the subjects for the rounds in which their payoff was determined, a number of practice rounds were provided along with explanations for the various components of the experiment. To avoid political jargon and thereby experimenter demand effects, the experiment was framed as a sales competition within a firm, "Buddy Company". Each participant was told they would be assigned to either Team A or Team B and then compete for contracts with customers in zones. Three zones made up a district and each region contained three districts. The practice rounds maintained this verbiage and walked participants through how their choices impacted their payoff and what was necessary in order for them to win the competition. For instance, to win a district a participant had to win at least two out of three zones and to win the region a participant had to win two out of the three districts.

We used a Tullock style competition for each zone with participants entering their choice of effort. The first series of practice rounds focused on participants competing for zones followed by rounds that explained how participants won districts. A similar process was followed for practice rounds involving descriptions of regions. Each series of practice rounds also made sure participants understood their probability of winning was tied directly to their choices. Short quizzes were designed to test whether such knowledge was salient.

After the practice rounds participants completed three stages. Each stage had five, three-by-three regions that differed in their configuration as shown in Figure 1. The districts were white, light grey, and dark grey.

Figure 1.



Some of the zones in certain districts, depending on the region, were preoccupied by contracts with either Team A or Team B. If both participants put forth the same efforts for every district then Team B had an advantage in region 1 (the furthest left region in Figure 1) and Team

A had an advantage in region 5 while regions 2,3, and 4 were all equally likely to be won by either team. With this design the gerrymandered regions were regions 1 and 5.

Next Steps

Moving forward we will do a few things differently. We will inform participants that they can ask questions at any time during the experiment. This was somewhat overlooked during the pilot, but seeing as the choices of participants were rational and in line with our expectations we believe there was little if any confusion. We will also investigate potential reasons for participants choosing to compete in gerrymandered districts during the veil of ignorance round. Our initial thought is that participants are simply willing to take the 50/50 chance that they will be on the team that is advantaged in that particular region. This phenomenon could also be due to confusion regarding the veil of ignorance stage and so requires further investigation in order to determine which causal mechanism is actually at work.

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Appendix

1 Equilibrium Concepts

1.1 Scenario 1

The first possible scenario is

$$[(rrr)(dd\_)(d\_\_)]$$

R wins the first district and D wins the second district for sure. For the last district, we need to calculate the probilitity each player wins.
The probability d wins the third district is:

$$p_d = \frac{e_d^2 + 2e_r e_d}{(e_d + e_r)^2} \tag{1}$$

The expected payoff of a player d is:

$$E\pi_d = p_d v - e_d = \frac{e_d^2 + 2e_r e_d}{(e_d + e_r)^2} v - e_d \tag{2}$$

The standard modelling approach is to maximize (2) with respect to player d's effort, which yields the first-order condition:

$$\frac{2e_r^2}{(e_d + e_r)^3} v - 1 = 0 \tag{3}$$

Similarly, the probability r wins the third district is:

$$p_r = \frac{e_r^2}{(e_d + e_r)^2} \tag{4}$$

The expected payoff of r is:

$$E\pi_r = p_r v - e_r = \frac{e_r^2}{(e_d + e_r)^2} v - e_r \tag{5}$$

The standard modelling approach is to maximize (5) with respect to player r's effort, which yields the first-order condition:

$$\frac{2e_r e_d}{(e_d+e_r)^2}v - 1 = 0 \tag{6}$$

Assuming an interior solution, the Nash equilibrium outcome is attained by solving (3) and (6) simultaneously for e_d and e_r. This equilibrium is:

$$\frac{2e_r^2}{(e_d+e_r)^3} = \frac{2e_r e_d}{(e_d+e_r)^2} \tag{7}$$

$$e_d = e_r \tag{8}$$

Since e_d=e_r=e, the likelihood of d or r wins the third district is $\frac{3}{4}$ and $\frac{1}{4}$ respectively and the equilibrium level of effort is e_d=e_r=$\frac{1}{4}$v. The corresponding expected payoff of d and r are $\frac{1}{2}$v and 0 respectively.

1.2 Scenario 2

The second possible scenario is

$$[(rr_{-})(dd_{-})(dr_{-})]$$

R wins the first district and D wins the second district for sure. We need to solve for the probilitity each player wins, but notice that both player has an advantage so it will be symmetric.
The probability d wins the third district is:

$$p_d = \frac{e_d}{(e_d+e_r)} \tag{9}$$

The expected payoff of a player d is:

$$E\pi_d = p_d v - e_d = \frac{e_d}{(e_d+e_r)}v - e_d \tag{10}$$

The standard modelling approach is to maximize (10) with respect to player d's effort, which yields the first-order condition:

$$\frac{e_r}{(e_d+e_r)^2}v - 1 = 0 \tag{11}$$

Assuming an interior solution, the Nash equilibrium outcome is attained by solving (11) simultaneously for e_d and e_r. This equilibrium is:

$$\frac{e_r}{(e_d+e_r)^2} = \frac{e_d}{(e_d+e_r)^2} \tag{12}$$

$$e_d = e_r \tag{13}$$

Since e_d=e_r=e, the likelihood of d or r wins the third district is $\frac{1}{2}$ and the equilibrium level of effort is e_d=e_r=$\frac{1}{4}$v. The corresponding expected payoff of d and r are $\frac{1}{4}$v.

1.3 Scenario 3

The third possible scenario is:

$$[(rrr)(ddd)(\_\_\_)]$$

R wins the first district and D wins the second district for sure. We need to solve for the probilitity each player wins, but no player has an advantage on the third district so it will be symmetric.
The probability d wins the third district is:

$$p_d = \frac{e_d^3 + 3e_d^2 e_r}{(e_d + e_r)^3} \tag{14}$$

The expected payoff of a player d is:

$$E\pi_d = p_d v - e_d = \frac{e_d^3 + 3e_d^2 e_r}{(e_d + e_r)^3} v - e_d \tag{15}$$

The standard modelling approach is to maximize (15) with respect to player d's effort, which yields the first-order condition:

$$\frac{6e_d e_r^2}{(e_d + e_r)^4} v - 1 = 0 \tag{16}$$

Assuming an interior solution, the Nash equilibrium outcome is attained by solving (16) simultaneously for e_d and e_r. This equilibrium is:

$$\frac{6e_d e_r^2}{(e_d + e_r)^4} = \frac{6e_d^2 e_r}{(e_d + e_r)^4} \tag{17}$$

$$e_d = e_r \tag{18}$$

Since e_d=e_r=e, the likelihood of d or r wins the third district is $\frac{1}{2}$ and the equilibrium level of effort is e_d=e_r=$\frac{3}{8}$v. The corresponding expected payoff of d and r are $\frac{1}{8}$v.

1.4 Scenario 4

The fourth possible scenario is:

$$[(rd\_)(rd\_)(rd\_)]$$

No player has an advantage over each district.
The probability d wins all three districts or at least two districts is:

$$p_d = p_1p_2p_3 + p_1p_2(1-p_3) + p_1(1-p_2)p_3 + (1-p_1)p_2p_3 \tag{19}$$

Since in equilibrium $p_1 = p_2 = p_3$, simplify (19)

$$p_d = p^3 + 3p^2(1-p) = \frac{e_d^3}{(e_d+e_r)^3} + \frac{3e_d^2e_r}{(e_d+e_r)^3} \tag{20}$$

The expected payoff of a player d is:

$$E\pi_d = p_dv - e_d = \frac{e_d^3}{(e_d+e_r)^3} + \frac{3e_d^2e_r}{(e_d+e_r)^3}v - 3e_d \tag{21}$$

The standard modelling approach is to maximize (21) with respect to player d's effort, which yields the first-order condition:

$$\frac{6e_de_r^2}{(e_d+e_r)^4}v - 3 = 0 \tag{22}$$

Assuming an interior solution, the Nash equilibrium outcome is attained by solving (3) and (6) simultaneously for e_d and e_r. This equilibrium is:

$$\frac{6e_de_r^2}{(e_d+e_r)^4} = \frac{6e_d^2e_r}{(e_d+e_r)^4} \tag{23}$$

$$e_d = e_r \tag{24}$$

Since e_d=e_r=e, the likelihood of d or r wins the third district is $\frac{1}{2}$ and the equilibrium level of effort is e_d=e_r=$\frac{1}{8}$v. The corresponding expected payoff of d and r are $\frac{1}{8}$v.