1 Background

I was asked to evaluate the potential political impact of population variances in the districting plans currently in effect for the state House and Senate. First, I discuss some historic factors that could affect apportionment statewide. One of the enduring cleavages in Georgia politics over the years has been the rural/urban divide. From early in the twentieth century, Georgia's economy industrialized rapidly, emphasizing the construction of railroads and the expansion of manufactures over the agrarian economy. Rural interests tended to be neglected in such an environment, thus polarizing public sentiment. The larger towns favored the New Deal, for instance, while the farmers resented federal intrusion into state-level policy prerogatives.

This conflict was formalized in Georgia's adoption of the "county unit system." Similar in spirit to the Electoral College, this system gave rural counties a disproportionate share of votes when electing statewide officials. As political scientist V.O. Key noted in 1949, "So long as the [unit] system prevails, it will exert a profound influence on the character of the state's politics. Fundamentally, its effect is that only those candidates for state office who can win pluralities in small, rural, two-unit-vote counties have a reasonable expectation of success." The urban opponents of this system unsuccessfully challenged its constitutionality in 1946, and continually chafed against the extra power it afforded rural voters until its abolition in 1962 following the *Baker v. Carr* one-person-one-vote ruling.

These rural/urban divisions continue in Georgia politics to the present day — disagreements on issues such as school construction funds, water rights, highways, and private prisons emphasize the differences in priorities of the two regions. “I can’t go back to the Montezuma Kiwanis Club and brag on the World Congress Center,” Sen. George Hooks, D-Americus, said during a recent debate. “They’ll throw me out the side door and into the Flint River.”[1] There are still stark economic differences as well: non-metro areas in the state, for instance, have poverty rates 50% higher than metro areas. To the extent that rural interests struggled to maintain their political power in Georgia’s recent reapportionment, against the tide of shifting populations, those rural legislators were acting in the same ways their predecessors had for decades.

2 Methodology

The remainder of this report quantifies the degree to which population deviations in the Georgia House and Senate districts affect individual voters of different partisan attachments. That is, on average, how much is the voting power of Republican and Democratic voters increased or decreased by less than ideally apportioned districts?

To answer this question, it would be inappropriate to simply look at the population deviations in Democratic leaning districts and compare those

[1] This quote was taken from Doug Gross, “Rural, urban lawmakers vie,” *Augusta Chronicle*, March 5, 2001.

figures to the deviations in districts that tend to be Republican. Doing so would not measure the relative impact of deviations on individual residents and voters because districts are not monolithic, but are composed of voters from both parties.

An example will illustrate this point. Consider a state with 5,000 residents, evenly divided between Democrats and Republicans, and 50 districts. Assume that, instead of being perfectly apportioned at 100 residents in each district, Districts 1 through 25 have 95 residents, for a -5% deviation, and Districts 26-50 have 105 residents, for +5%. Let Districts 1 through 24 have 48 Democrats and 47 Republicans, District 25 have only 95 Republicans, District 26 have 100 Democrats and 5 Republicans, and Districts 27-50 have 52 Democrats and 53 Republicans.

Then 24 of the 25 under-apportioned districts have Democrat majorities and 24 of the 25 over-apportioned districts have Republican majorities, so that there is an almost perfect correlation between Democrat performance and under-apportionment. Yet overall, the Republicans' vote weight is 1.01 and the Democrats' is 0.99, meaning that Republican voters on average gain from the deviations, while Democrats lose. This occurs because—even though the district deviations overall appear to favor Democrats—there are many Republican voters who reside in the lower deviation districts.

To measure the partisan impact of deviations, then, one has to look at both the deviation in each district and the relative fraction of the population in the district that tends to vote Republican and Democratic. Only by looking at both of these factors can one estimate at all the actual impact on voters, which is consistent with the one-person-one-vote philosophy of *Baker v. Carr* and later cases.

Thus, there are two key variables in determining the relative "vote weight" of persons who tend to vote Republican or Democratic. One of these variables is the ratio of the actual population in a given district to its ideal size. The other is the relative percentage of Republicans and Democrats living in that district.

The ratio of the ideal population to the actual population summarizes the increase (or decrease) in influence due to unequal district sizes. I calculate this ratio and then attach it to each voter in a district and average the ratios for voters of each party across all districts. That average for all voters, by party, gives the relative partisan impact that deviations have on all persons.

To translate this analysis into explicit calculations, I use the standard mathematical formula for a weighted average. Consider a population divided among K districts. We will assume initially that all districts are single-member, and then extend the analysis to multi-member districts. If the state population is N, then the ideal district population will be

$$P^* = N/K. \tag{1}$$

Let the actual population in district d be P_d. Then define the apportionment ratio in district d to be

$$M_d = P^*/P_d. \tag{2}$$

We wish to average the quantity M_d across voters of each party in the state. In district d, assume that there are Rep_d Republicans and Dem_d Democrats. Then the average apportionment ratio for Republicans is

$$M_{\text{Rep}} = \frac{\sum_d \text{Rep}_d \, M_d}{\sum_d \text{Rep}_d}, \tag{3}$$

and for Democrats is

$$M_{\text{Dem}} = \frac{\sum_d \text{Dem}_d \, M_d}{\sum_d \text{Dem}_d}. \tag{4}$$

The quantities Rep_d and Dem_d are, in turn, calculated using some measure of partisan division in each district; for instance, Democratic Performance statistics or the percent of a district favoring the Democratic candidate in a given election. If a proportion α_d of district d is Democratic, then

$$\text{Rep}_d = P_d * (1 - \alpha_d), \tag{5}$$

and

$$\text{Dem}_d = P_d * \alpha_d. \tag{6}$$

Note three aspects of these calculations. First, if all districts are perfectly apportioned, then $P_d = P^*$ in all districts, so all the values of M_d are 1.00, implying from Equations 3 and 4 that $M_{\text{Rep}} = M_{\text{Dem}} = 1.00$, regardless of the deviations. That, of course, is what one would expect. Second, ratios over 1.00 indicate that voters receive a higher weight through apportionment, and ratios under 1.00 indicate the opposite.

Finally, the analysis also automatically accounts for the presence of multi-member House districts. Say a voter lives in a district containing n seats. The ideal population of such a district is n times the population of a single-member district. Such a voter will have $1/n$'th the influence over each representative, but will be able to do so for n representatives. Thus these two effects cancel out, and so using the formulas above with optimal district size $n * P^*$ and actual voters P_d gives the correct answer. Therefore we treat multi-member districts as n separate districts, each with population P_d/n and with apportionment ratio $(n * P^*)/P_d$.

3 Findings

3.1 Data

To carry out the analysis indicated in the previous section, I used total district population and deviation numbers supplied to me by the Georgia State Legislative Reapportionment Office. From these, I calculated the values of P^* and M_d using Equations 1 and 2.

In calculating the numbers of Republicans and Democrats in each district (Rep_d and Dem_d), I used the overall Democratic Performance as measured by the Reapportionment Office using elections from 1996 to 2000 (DP96-00), which is data that was available at the time of the original redistricting. I then determine the average vote weight for Democrat and Republican individuals, for both the House and Senate.[2]

3.2 Results

The results of the analysis are shown in Table 1. As seen in the table, the impact of district population deviations at the individual level is less than 1%. This result is due to the fact that, although the more pro-Democrat districts did tend to be under-apportioned, they had significant numbers of Republican voters in them as well, and so the under-apportionment favors these voters as well. Averaging out these effects over districts, the advantage to Democrat voters based on Democratic Performance statistics is negligible—an average of +0.64% for the House and +0.88% for the Senate.

	Republican	Democrat
House	0.9935	1.0064
Senate	0.9911	1.0088

Table 1: Vote Weight Analysis Results

[2]The analysis could also be performed weighting each district by the number of registered voters. The unweighted analysis used below treats all state residents equally and is thus more consistent with *Baker v. Carr*, which focuses on population equality. Introducing weights based on registered voters would not substantially change the results.

3.3 Discussion

Furthermore, political affiliation, unlike more permanent characteristics like race, can change over time. Areas in which one party loses elections at one point in time can be competitive, or even turn strongly towards the other party, in a relatively short time. Any number of factors can effect such a change: partisan voters may switch their party affiliations, independent voters can shift their allegiances, candidates of varying qualities can run for office, and so on. Of course, demographic changes in a district can also cause significant changes in voting patterns over a short period of time.

Given the inherent variability in politics, then, it may well be that even the small Democratic voter weight advantage reflected in the DP96-00 election data overstates any actual advantage. Tables 2 and 3 list districts in the Senate and House, respectively, that have DP96-00 indices over 50%, yet which voted for a Republican candidate in recent statewide elections—including the Bush v. Gore presidential vote in 2000; the 2002 Perdue v. Barnes governor's race (with a Democrat incumbent); the 2002 Chambliss v. Cleland Senate race (with a Democrat incumbent); and the 2002 Kathy Cox v. Christmas Education Commissioner race (for an open seat). As shown in the table, all 16 of these Democratically Performing Senate districts voted in the majority for Bush in the 2000 presidential election, 11 voted for Chambliss, 12 for Kathy Cox, and 13 for Perdue for governor. Similarly, 34 of the Democratically Performing House districts voted for Bush, 24 for Chambliss

District	Bush	Chambliss	K. Cox	Perdue
3	●	○	○	●
7	●	●	●	●
8	●	●	●	●
11	●	●	●	●
13	●	●	●	●
14	●	○	○	●
18	●	●	●	○
19	●	●	●	●
20	●	●	●	●
23	●	○	○	○
25	●	●	●	●
29	●	○	●	●
31	●	●	●	●
46	●	○	○	○
47	●	●	●	●
52	●	●	●	●

Table 2: Democratically Performing Senate Districts that Voted for Republican Candidates

District	Bush	Chambliss	K. Cox	Perdue
11	●	●	●	●
13	●	●	●	●
19	●	●	●	●
20	●	●	●	●
23	●	●	●	●
72	●	○	●	●
77	●	●	●	●
78	●	●	●	●
92	●	○	●	●
93	●	●	●	●
94	●	○	●	●
95	○	○	●	○
99	●	○	●	○
102	●	●	○	●
104	●	●	●	●
108	●	●	●	●
109	○	○	●	○
112	●	○	●	○
116	●	○	○	○
118	●	●	●	●
119	●	●	●	●
122	●	●	●	●
130	●	●	●	●
131	●	●	●	●
132	●	●	●	●
134	●	○	○	○
138	●	●	●	●
139	●	●	●	●
140	●	○	○	○
141	●	○	●	○
142	●	●	●	●
143	●	●	●	●
144	●	●	●	●
145	●	●	●	●

Table 3: Democratically Performing House Districts that Voted for Republican Candidates

and 32 for Cox.

It is thus certainly possible for Republican candidates to win in many of these districts. Moreover, of the 28 Senate districts that are both under-apportioned and majority Democrat, 13 voted for Bush in 2000. Similarly, in the House, of the 78 under-apportioned democratic districts, 22 voted for Bush. If we restrict attention to only those districts with population deviations more than -2.5%, then 8 of 21 such Democratically performing districts in the Senate voted for Bush, 6 for Chambliss and 6 for Cox. In the House, of the 60 Democratically performing districts under -2.5%, 20 went for Bush 10 for Chambliss and 17 for Cox.

A House Deviations

Table 4: House Districts, Deviations, Democratic Performance, and Support for Republican Candidates

District	Deviation	DP96-00	Bush	Chambliss	Cox	Perdue
1	-3.27%	46.46%	•	•	•	•
2	3.25%	38.91%	•	•	•	•
3	4.74%	37.05%	•	•	•	•
4	4.92%	37.08%	•	•	•	•
5	1.87%	47.05%	•	•	•	•
6	3.80%	39.77%	•	•	•	•
7	4.15%	42.11%	•	•	•	•
8	0.45%	48.52%	•	•	•	•
9	4.88%	37.55%	•	•	•	•
10	-3.03%	44.46%	•	•	•	•
11	-0.17%	52.23%	•	•	•	•
12	4.13%	44.46%	•	•	•	•
13	3.99%	52.30%	•	•	•	•
14	4.48%	28.40%	•	•	•	•
15	3.89%	28.12%	•	•	•	•
16	4.78%	30.64%	•	•	•	•
17	4.82%	28.47%	•	•	•	•

18	-4.39%	49.53%	•	•	•	•
19	-4.78%	56.89%	•	•	•	•
20	4.75%	50.57%	•	•	•	•
21	4.25%	33.40%	•	•	•	•
22	-4.74%	48.50%	•	•	•	•
23	-2.75%	50.78%	•	•	•	•
24	-2.16%	39.74%	•	•	•	•
25	-4.94%	48.43%	•	•	•	•
26	4.97%	35.84%	•	•	•	•
27	3.14%	44.51%	•	•	•	•
28	4.98%	26.64%	•	•	•	•
29	4.69%	33.00%	•	•	•	•
30	4.57%	29.35%	•	•	•	•
31	4.35%	32.41%	•	•	•	•
32	4.76%	35.15%	•	•	•	•
33	-0.22%	53.79%	○	○	○	○
34	-4.42%	52.83%	○	○	○	○
35	4.98%	34.28%	•	•	•	•
36	3.02%	27.94%	•	•	•	•
37	4.38%	31.04%	•	•	•	•
38	4.32%	23.67%	•	•	•	•
39	4.55%	29.78%	•	•	•	•
40	4.17%	36.24%	•	•	•	•

41	4.94%	37.14%	•	•	•	•
42	-3.69%	53.34%	○	○	○	○
43	4.80%	69.65%	○	○	○	○
44	-0.68%	70.79%	○	○	○	○
45	1.37%	79.80%	○	○	○	○
46	4.24%	37.52%	•	•	•	•
47	2.22%	67.32%	○	○	○	○
48	-2.74%	67.90%	○	○	○	○
49	-4.99%	91.90%	○	○	○	○
50	-4.99%	84.27%	○	○	○	○
51	-3.97%	86.38%	○	○	○	○
52	2.00%	33.61%	•	•	•	•
53	0.39%	53.64%	○	○	○	○
54	-0.16%	57.16%	○	○	○	○
55	-4.45%	68.02%	○	○	○	○
56	-4.96%	55.90%	○	○	○	○
57	-4.90%	74.93%	○	○	○	○
58	-4.45%	88.43%	○	○	○	○
59	-4.14%	73.09%	○	○	○	○
60	-4.66%	67.86%	○	○	○	○
61	-0.74%	65.54%	○	○	○	○
62	4.65%	68.70%	○	○	○	○
63	1.21%	36.70%	•	•	•	•

64	2.91%	33.07%	•	•	•	•
65	-0.76%	31.82%	•	•	•	•
66	0.80%	53.76%	○	○	○	○
67	4.95%	30.50%	•	•	•	•
68	-4.71%	41.36%	•	•	•	•
69	-2.71%	54.35%	○	○	○	○
70	3.05%	31.68%	•	•	•	•
71	1.82%	30.73%	•	•	•	•
72	-4.56%	54.86%	•	○	•	•
73	0.15%	40.40%	•	•	•	•
74	4.70%	56.20%	○	○	○	○
75	-1.50%	69.89%	○	○	○	○
76	-1.46%	43.30%	•	•	•	•
77	4.82%	53.13%	•	•	•	•
78	3.79%	52.74%	•	•	•	•
79	-1.56%	33.03%	•	•	•	•
80	-2.12%	27.19%	•	•	•	•
81	-2.46%	84.59%	○	○	○	○
82	-4.45%	56.96%	○	○	○	○
83	-2.11%	70.87%	○	○	○	○
84	2.80%	53.10%	○	○	○	○
85	4.30%	31.59%	•	•	•	•
86	4.84%	28.74%	•	•	•	•

87	4.93%	37.41%	●	●	●	●
88	-3.09%	49.31%	●	●	●	●
89	-0.82%	40.91%	●	●	●	●
90	-4.40%	59.02%	○	○	○	○
91	0.26%	45.32%	●	●	●	●
92	-4.60%	52.14%	●	○	●	●
93	-2.50%	53.30%	●	●	●	●
94	-4.29%	55.06%	●	○	●	●
95	-1.96%	56.61%	○	○	●	○
96	2.98%	46.02%	●	●	●	●
97	-4.29%	63.59%	○	○	○	○
98	-2.82%	69.00%	○	○	○	○
99	-4.87%	53.73%	●	○	●	○
100	-2.83%	62.56%	○	○	○	○
101	4.95%	48.76%	●	●	●	●
102	2.93%	53.43%	●	●	○	●
103	-3.67%	58.33%	○	○	○	○
104	0.13%	54.39%	●	●	●	●
105	3.36%	72.81%	○	○	○	○
106	4.47%	38.11%	●	●	●	●
107	4.53%	74.88%	○	○	○	○
108	2.76%	50.40%	●	●	●	●
109	-2.43%	50.68%	○	○	●	○

110	0.57%	36.76%	•	•	•	•
111	-4.48%	73.15%	○	○	○	○
112	-3.58%	53.13%	•	○	•	○
113	-3.68%	75.04%	○	○	○	○
114	-1.55%	65.66%	○	○	○	○
115	-2.48%	48.60%	•	•	•	•
116	-3.01%	58.60%	•	○	•	○
117	4.99%	37.38%	•	•	•	•
118	-3.89%	52.23%	•	•	•	•
119	-3.47%	51.74%	•	•	•	•
120	2.75%	48.75%	•	•	•	•
121	4.27%	48.43%	•	•	○	•
122	1.77%	50.91%	•	•	•	•
123	4.98%	34.91%	•	•	•	•
124	-4.60%	67.67%	○	○	○	○
125	-1.84%	59.40%	○	○	○	○
126	4.79%	26.21%	•	•	•	•
127	4.80%	46.41%	•	•	•	•
128	-1.82%	58.90%	○	○	○	○
129	4.51%	47.98%	•	•	•	•
130	-1.01%	51.14%	•	•	•	•
131	1.89%	54.39%	•	•	•	•
132	-4.78%	53.64%	•	•	•	•

133	-4.63%	62.28%	○	○	○	○
134	-4.93%	62.07%	●	○	○	○
135	-4.60%	68.20%	○	○	○	○
136	-4.68%	68.93%	○	○	○	○
137	4.45%	40.90%	●	●	●	●
138	3.10%	54.80%	●	●	●	●
139	-3.11%	52.90%	●	●	●	●
140	-4.77%	59.21%	●	○	○	○
141	-4.94%	54.19%	●	○	●	○
142	-4.75%	54.04%	●	●	●	●
143	-4.89%	55.32%	●	●	●	●
144	2.21%	53.49%	●	●	●	●
145	-3.86%	51.78%	●	●	●	●
146	4.81%	29.01%	●	●	●	●
147	-3.99%	43.28%	●	●	○	●

B Senate Deviations

Table 5: Senate Districts, Deviations, Democratic Performance, and Support for Republican Candidates

District	Deviation	DP96-00	Bush	Chambliss	Cox	Perdue
1	0.0139	0.2931	•	•	•	•
2	-0.0312	0.6835	◦	◦	◦	◦
3	0.024	0.5181	•	◦	◦	•
4	0.001	0.4545	•	•	•	•
5	0.0321	0.5406	◦	◦	◦	◦
6	-0.0499	0.5234	◦	◦	•	◦
7	-0.0447	0.5157	•	•	•	•
8	-0.0408	0.5582	•	•	•	•
9	0.0498	0.3184	•	•	•	•
10	-0.0496	0.7247	◦	◦	◦	◦
11	-0.0361	0.5295	•	•	•	•
12	-0.0415	0.6305	◦	◦	◦	◦
13	-0.047	0.5249	•	•	•	•
14	-0.0402	0.5811	•	◦	◦	◦
15	-0.0467	0.6591	◦	◦	◦	◦
16	0.0497	0.3667	•	•	•	•
17	0.0497	0.3518	•	•	•	•

18	-0.0008	0.5136	●	●	●	●
19	-0.0483	0.5102	●	●	●	●
20	-0.0491	0.5309	●	●	●	●
21	0.0498	0.304	●	●	●	●
22	-0.0485	0.6228	○	○	○	○
23	-0.0486	0.5299	●	○	○	○
24	0.0425	0.3348	●	●	●	●
25	0.0078	0.5602	●	●	●	●
26	-0.0439	0.6894	○	○	○	○
27	0.0459	0.2812	●	●	●	●
28	0.0497	0.3119	●	●	●	●
29	-0.0097	0.5403	●	○	●	●
30	0.0491	0.3843	●	●	●	●
31	-0.0138	0.5168	●	●	●	●
32	0.0486	0.3229	●	●	●	●
33	-0.0497	0.5474	○	○	○	○
34	-0.0181	0.5967	○	○	○	○
35	-0.0176	0.7459	○	○	○	○
36	-0.0473	0.844	○	○	○	○
37	0.0333	0.3195	●	●	●	●
38	-0.0476	0.7404	○	○	○	○
39	-0.0498	0.7656	○	○	○	○
40	0.0484	0.5553	○	○	○	○

41	0.0289	0.5347	○	○	○	○
42	0.0464	0.5612	○	○	○	○
43	-0.0479	0.7219	○	○	○	○
44	0.0209	0.556	○	○	○	○
45	0.0497	0.314	•	•	•	•
46	-0.0139	0.5412	•	○	•	○
47	-0.0041	0.5289	•	•	•	•
48	0.0479	0.3111	•	•	•	•
49	0.0461	0.3634	•	•	•	•
50	-0.0218	0.4862	•	•	•	•
51	0.0499	0.3794	•	•	•	•
52	0.0266	0.5292	•	•	•	•
53	0.0497	0.3797	•	•	•	•
54	0.0468	0.4356	•	•	•	•
55	-0.0497	0.6886	○	○	○	○
56	0.0497	0.3224	•	•	•	•