

IN THE UNITED STATES DISTRICT COURT  
MIDDLE DISTRICT OF FLORIDA  
TAMPA DIVISION

KETO NORD HODGES, et al.,

*Plaintiffs,*

v.

Case No. 8:24-cv-879

KATHLEEN PASSIDOMO, et al.,

*Defendants.*

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**EXPERT REPORT OF DR. D. STEPHEN VOSS**

I. INTRODUCTION

- A. I am a political scientist who earned his Ph.D. from Harvard University in 2000, with **political methodology** (i.e., quantitative analysis) as my Focus Field. I currently am employed with the University of Kentucky's Department of Political Science, where I am tenured at the Associate Professor rank and fill two administrative positions, Internship Director and Publicity Coordinator. I am my College's representative on the Faculty Senate. I have served as president of the Kentucky Political Science Association and I co-founded that association's journal.
- B. My dissertation explored **elections and voting behavior in the U.S. South**,<sup>1</sup> and I have been publishing scholarly work in that topical area since 1996,<sup>2</sup> including in peer-reviewed disciplinary journals. Some of that work specifically focused on redistricting or African-American voting rights.<sup>3</sup> Prior to that, I worked as a political reporter, covering Louisiana elections and legislative politics for Gannett News.
- C. My primary Ph.D. advisor was Gary King, originator of commonly used methods and software for conducting **ecological inference**. I was on the ground floor when King wrote the 1997 book introducing his method, as illustrated by the use of my data in his book's opening analysis,<sup>4</sup> and I authored a chapter in King's follow-up edited volume.<sup>5</sup> I employed

King’s EI software throughout my dissertation,<sup>6</sup> and I have published work using EI in both peer-reviewed<sup>7</sup> and trade<sup>8</sup> journals. Another of my dissertation advisors was Bradley Palmquist, also a specialist in ecological inference. A conference paper Palmquist and I coauthored to help introduce EI has enjoyed widespread visibility due to its influence on a prominent racial-politics scholar; it has been “read” more than 5,000 times just through ResearchGate.<sup>9</sup>

- D. I am interviewed frequently by state, national, and international news organizations as a **non-partisan commentator**. I’ve served as faculty advisor for student groups across the political spectrum – including, currently, UK’s College Democrats. I also work as a political analyst for Spectrum One News, after a long stint as an analyst for ABC-36 (WTVQ). I am a recurring guest and periodic guest host on WVLK talk radio, and I am a recurring columnist for a progressive outlet, the *Kentucky Lantern*.
- E. Although I do not pursue, and usually turn down, offers to engage in consulting work, I have served as a **consultant and expert witness** in a handful of redistricting and voting-rights cases, starting with an Indianapolis case early in my career for which I performed ecological inference. I’ve also been admitted as a quantitative-analysis expert in cases unconnected to elections and voting, usually related to automobile risk analysis, although I haven’t worked such cases in a long time.
- F. Attached to this expert report is my CV, which lists my publications and cases in which I provided expert testimony.

## II. ASSIGNMENT & SCOPE OF WORK

- A. Counsel retained me to evaluate the report submitted by Dr. Matthew Barreto and, by extension, the maps/report submitted by Dr. Corey McCartan.
- B. To evaluate the Barreto report – specifically, the ecological inferences described therein – I employ the same ecological-inference software as Barreto, using my adaptations of the code he provided to exemplify his approach.
- C. To evaluate the McCartan maps, and compare them to both the enacted and the obsolete “benchmark” maps, I use the same resource McCartan does: Dave’s Redistricting App (DRA). I also combined the McCartan maps with results from the ecological-inference software to extend Barreto’s performance analysis.

- D. As compensation for accepting this assignment, I was retained at a pay scale of \$400 per hour billed, with an additional \$50 for time spent under oath. I was assisted in this work by a part-time employee of my consulting partnership, Dr. Corrine F. Elliott (Ph.D. in Statistics, UC Berkeley). Neither her compensation nor mine was dependent on the results of our analysis or on the conclusions in this report. Because I supervised and vetted all work, I take responsibility for everything presented here.
- E. I advised counsel to request from Plaintiff's experts all data and code used to produce their submitted reports, as well as all statistical output being analyzed. That expectation was not met. I did not receive actual output from any of Barreto's ecological inferences, even though that's possible to provide. Nor did I receive all code Barreto claims to have run, just sample code for a single inference – with bugs that prevented it from being run without fixes. I was not provided all of Barreto's processed data; I was provided URL's linking to online data that did not reflect whatever processing he might have conducted. Even if I had been provided all of Barreto's inputs, it would have been impossible to duplicate Barreto's output exactly due to an error in his code.<sup>10</sup> For these reasons, when I attempt to evaluate the work of Plaintiff's experts, I am forced to do so not by scrutinizing their own results, but instead based on a good-faith attempt to replicate what they've done.

### III. THE MAPS BEING EVALUATED

- A. I gained access to **all five maps** relevant to the Barreto and McCartan reports: the enacted State Senate map, the obsolete "benchmark" State Senate map, and the three "illustrative" maps McCartan drew up for the ACLU (lettered A, B, and C).<sup>11</sup>
- B. State Senate District 16, as enacted, meets **standard redistricting criteria**. The district is *contiguous*; it is possible to connect all points within the district without crossing another district. It falls within the population tolerances required to meet the One Person One Vote *equal-population* standard. And it is relatively *compact*, falling within the range of Florida's other Senate districts on the three compactness measures calculated by DRA.<sup>12</sup> SSD16 is better than the district it replaced on two of those three metrics. *Based on shape, nothing about SSD16 looks unreasonable.*
- C. The compactness of SSD16 also holds up well when compared to the hypothetical replacements that McCartan and the ACLU put forward

TABLE 1 – Compactness Scores for Select Hillsborough County Districts

District	P-P	Reock	KIWYSI	District	P-P	Reock	KIWYSI
16 ACLU C	0.377	0.432	61	23 Enacted	0.555	0.564	92
16 Enacted	0.361	0.376	50	23 ACLU-C	0.421	0.420	69
16 ACLU B	0.324	0.391	55	20 Enacted	0.421	0.386	61
16 ACLU A	0.274	0.351	46	20 ACLU-C	0.408	0.405	60
19 Obsolete	0.260	0.407	40				

NOTE: The Polsby-Popper, Reock, and KIWYSI scores are the three measures of compactness computed in Dave’s Redistricting App (DRA). High scores represent more-compact districts.

(see Table 1 on left). The enacted SSD16 significantly outperforms the one in ACLU-A, beating it on all three compactness scores, and it is comparable to the one in ACLU-B. Only ACLU-C’s hypothetical 16<sup>th</sup> District consistently improves the compactness scores, but it does so at the expense of the compactness of SSD20 and especially SSD23 (see Table 1 on right). *The ACLU maps do not offer any reason to conclude that SSD16, as enacted, deviated from compactness in order to pursue ulterior motives.* If anything, the ACLU-A plan is the one that stands out as suspiciously untidy.

- D. *State Senate District 16 does not exhibit common indicators of manipulative gerrymandering.* It overlaps significantly with the obsolete district it replaced, SSD19, *preserving the district core* (see Figure 1). And it remains entirely within a single Metropolitan Statistical Area, uniting two population clusters within that MSA rather than linking disparate *communities of interest*.

FIGURE 1 – Comparing the Enacted SSD16 with the Obsolete SSD19 It Replaced

State Senate District 19 for 2020 Election

State Senate District 16 for 2022 Election

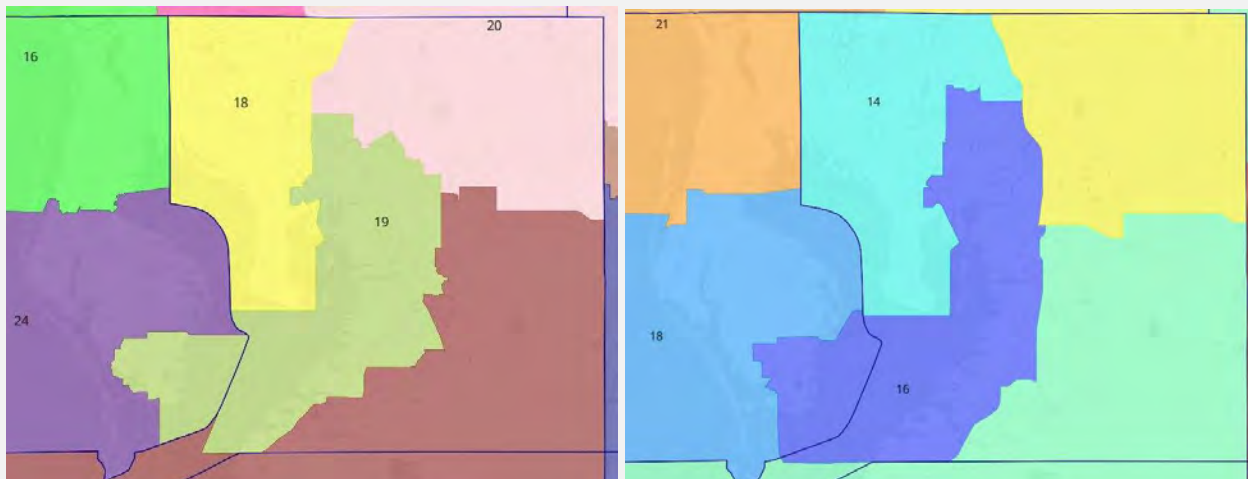


TABLE 2 – Partisanship in the Tampa-St. Petersburg-Clearwater Metropolitan Statistical Area (MSA)

County	Total	Democratic Voters		Republican Voters		Other Voters	
	Population	Count	Percent	Count	Percent	Count	Percent
Hillsborough	1,459,762	296,341	51.4%	268,092	46.5%	12,152	2.1%
Pinellas	959,107	229,446	48.5%	229,466	49.1%	11,104	2.3%
Pasco	561,891	91,577	38.9%	137,996	58.7%	5,642	2.4%
Hernando	194,515	31,322	35.2%	55,745	62.6%	2,040	2.3%
TOTAL for MSA	3,175,275	648,686	47.3%	691,299	50.4%	30,938	2.3%

NOTE: The electorate's partisanship is a 2016-2020 composite created by Dave's Redistricting App (DRA) using returns from six contests: the two presidential elections (2016 & 2020), the two Senate races (2016 & 2018), and two statewide contests from 2018 (governor & attorney general).

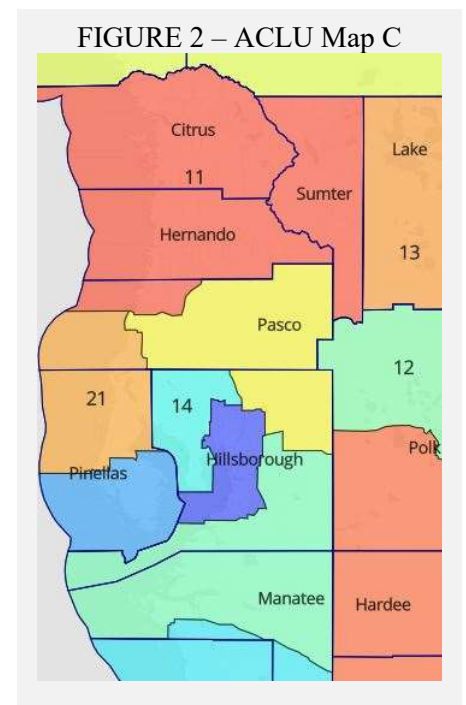
- E. Judged by past voting behavior, the districts drawn for the MSA do not show signs of extreme partisan gerrymandering. The MSA as a community of interest is evenly divided between Republicans and Democrats, with the electorate slightly tilting toward the GOP based on information on partisan lean that would have been available by the end of 2020. Table 2 illustrates this claim using a composite of Florida voting patterns observed from 2016-2020. The MSA contained almost 700k Republican votes (or 50.4% of the electorate), almost 650k Democratic votes (or 47.3%), and almost 31k others. The MSA is too small to envelop the entirety of six districts, but it easily surpasses the size needed to support five, so if the districts are going to reflect the partisanship of the area, I might expect to see two Democratic-leaning districts, and perhaps a third that's competitive for them. And that's exactly what DRA reports for the enacted map. SSD16 is solidly Democratic, SSD14 tilts Democratic, and with SSD18 only tilting Republican, it should be in play if the Democrats recruit and support a strong candidate. *Districts in the Tampa region look, in partisan terms, roughly as one would expect had mapmakers been trying to embed fair districts within the relevant Metropolitan Statistical Area.*<sup>13</sup>
- F. Of course, by creating two competitive districts – and risking that Democrats in the metro area might, at some point, hold a disproportionate share of the area's seats – the GOP received a corresponding benefit. Republicans obviously have the potential to win over enough of the Democratic-leaning electorate in SSD14 to take the district,<sup>14</sup> and if they hold on to SSD18 as well, that leaves their rivals with only one area seat in a legislative session, not the expected two. The Plaintiff expert reports appear to suggest that, by creating the opportunity for an extra Republican seat – even if it's far from



guaranteed – the mapmakers engaged in partisan gerrymandering. It is worth asking, therefore, whether Dr. McCartan’s proposed departures from the enacted map look like what would emerge from a neutral mapmaking process, one free from partisan or racial gerrymandering. After all, what McCartan’s offering the Court are manually drawn substitutes, which due to the informal nature of their construction could have incorporated (consciously or unconsciously) any number of impermissible considerations.

G. I see multiple indications that McCartan’s hypothetical maps are not “illustrative” of what would have emerged innocently from a mapmaker using neutral criteria. Rather, his proposed departures from the enacted plan are fully consistent with what one would propose if trying to promote the Democratic Party’s electoral interests based on partisan motives:

1. McCartan insists on hardening the border between Hillsborough and Pinellas counties, even though that line cuts through the heart of a major metropolitan area. Yet he shows no such concern for other county borders (see Figure 2, which presents the presumed flagship in the ACLU map flotilla). Within the MSA, he keeps Pasco County not just split but multisplit, sharing separate districts with Hillsborough, Pinellas, and Hernando. Meanwhile, he’s still got one district extending out of the MSA to join Manatee County to the south, and another that extends well to the north. *Unique fidelity to the border between Tampa and St. Petersburg, an interior MSA partition, makes sense if the goal is to advance Democratic interests.* It squeezes urban voters in separate directions, so they can overpower more GOP territory.



2. In drawing his “illustrative” maps, McCartan chooses to freeze SSD14, in northwest Hillsborough County. Notably, that is the district in the MSA that slightly tilts Democratic. Imposing such a restriction ensures that any subsequent alterations to Tampa’s district, to make up for the loss of St. Petersburg, must come from the south and east, territory previously in GOP-leaning districts. If McCartan’s tinkering pulls in Republican areas from the south or east, then the new Tampa district can dilute GOP voting power (cracking it). If he pulls in outlying Democratic areas, he leaves the remaining districts more

TABLE 3 – Packing and Cracking Republican Voters

District	Enacted Map		McCartan's Adjusted GOP Share		
	Democratic %	Republican %	ACLU-C	ACLU-B	ACLU-A
SSD14	49.90%	47.98%	47.98%	47.98%	47.98%
SSD16	68.66%	29.43%	34.99%	33.36%	33.45%
SSD18	46.10%	51.37%	45.33%	45.33%	45.33%
SSD20	41.28%	56.66%	58.17%	58.69%	58.73%
SSD23	42.30%	55.47%	57.28%	57.28%	57.33%

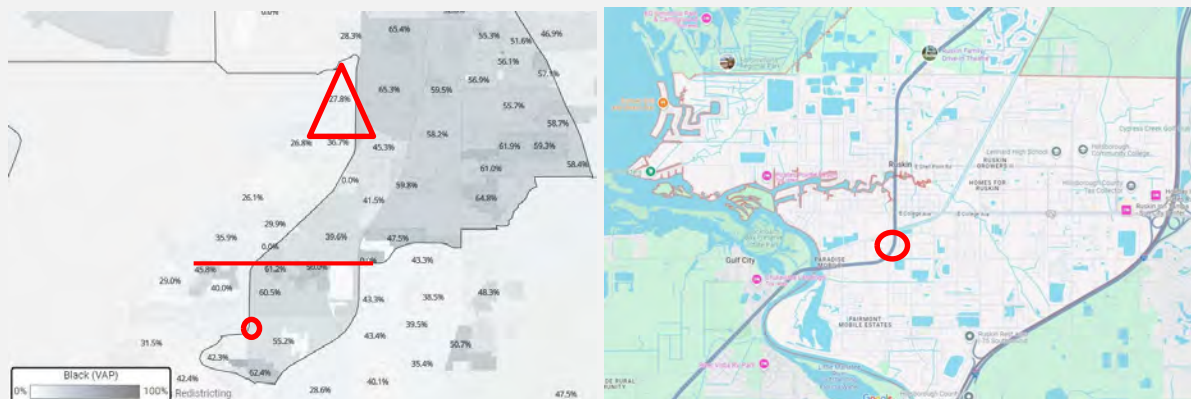
NOTE: McCartan's hypothetical maps not only flip SSD18 from leaning Republican to leaning Democratic, they freeze the competitive and slightly Democratic-tilted SSD14 so that any changes crack the Republican vote around Tampa (burying part of it in SSD16) and while packing outlying Republican voters into two more-lopsided districts (i.e., SSD20 and SSD23).

lopsided, diluting Republican voting power by creating more excess GOP votes (packing it). Indeed, as Table 3 shows, this combination of *cracking and packing Republican voters is precisely how the ACLU maps deviate from what the state enacted*. McCartan's manually drawn maps do more than just flip SSD18 so that it leans toward the Democratic Party instead of the GOP. He also cracked the region's Republican vote, compared to the enacted map, increasing by 4-5 points the share of SSD16 that will consist of "wasted" Republican

FIGURE 3 – The ACLU Tendril Splits Ruskin in Half, Scooping Out the More Democratic Portion

ACLU-A State Senate District 16

Google Map of Ruskin



NOTE: McCartan's first step in creating a new Tampa district included kicking much of the coastline north and south of Ruskin, as well as the western part of that town, out of the Tampa district. That choice was not neutral politically/racially: The grayscale shading shows the density of the Black population, while the percentages indicate the Democratic share of the 2016-2020 composite vote. The two circles indicate the same bend on U.S. Highway 41, showing how the district line splits Ruskin in half. ACLU-B added back the triangle. Only ACLU-C lops off the tendril to improve compactness, kicking out everything below the line fragment (i.e., below 19<sup>th</sup> Ave.) while pulling the coastline north of it back in.

votes. Meanwhile, he has packed more Republicans into SSD20 and SSD23, making them more lopsided.

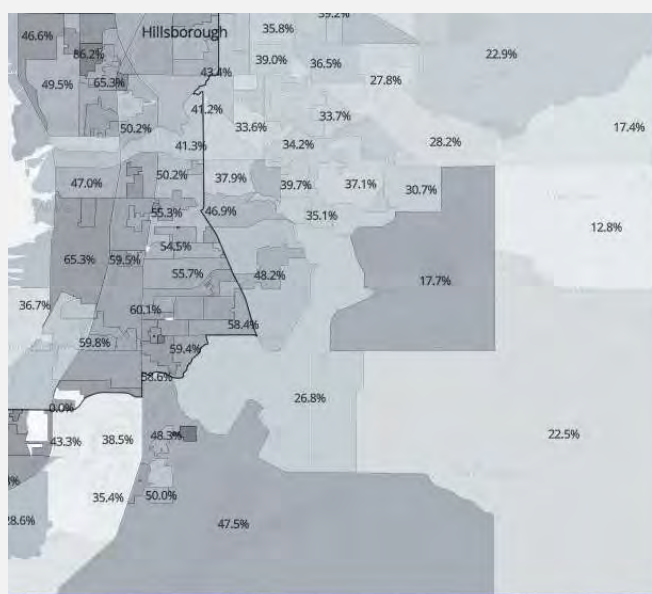
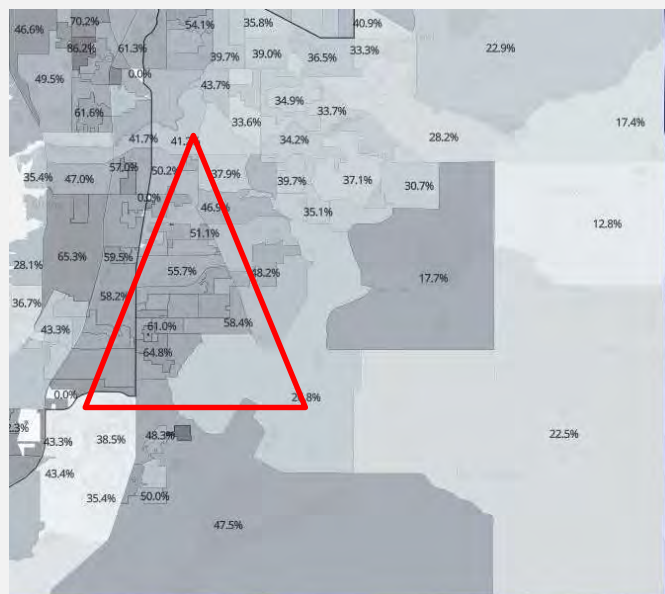
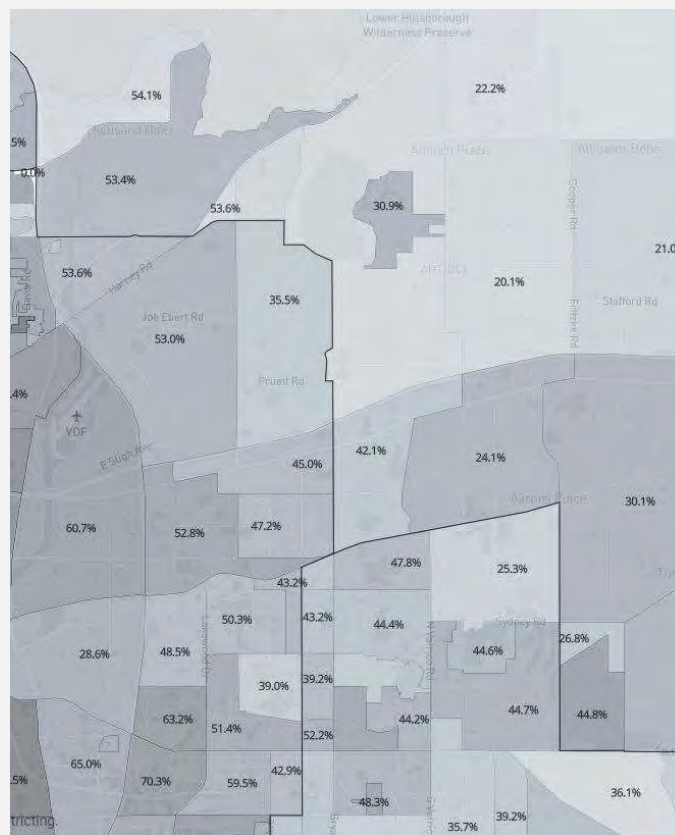
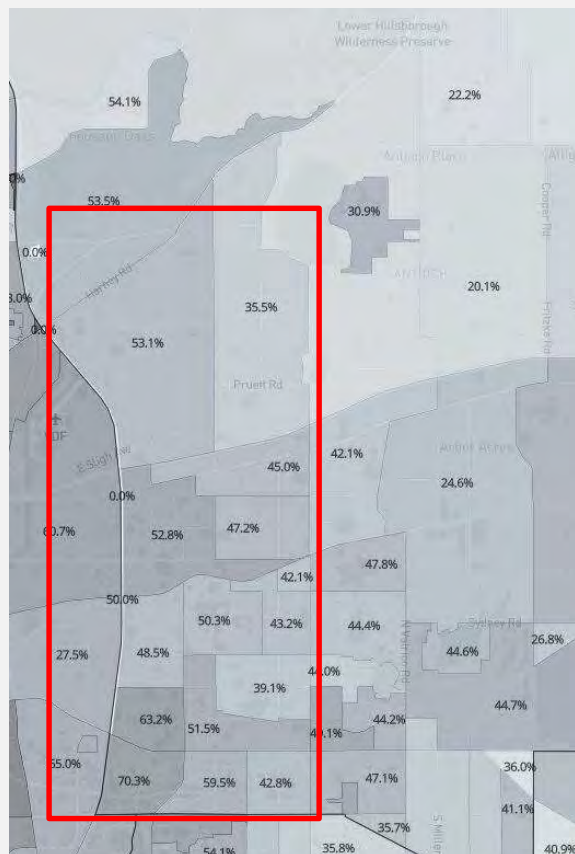
3. Unlike the enacted SSD16 – criticized for grouping, at the macro level, the MSA’s two urban cores – the ACLU-sponsored reshaping of SSD16 engages in some combination of racial and partisan gerrymandering at the micro level. This systematic effort is apparent from the series of steps McCartan takes to construct the flagship ACLU-C map. Initially, ACLU-A kicks much of the Hillsborough County coastline out of the district, leaving only a tendril that extends into SSD20 and splits the Florida town of Ruskin in half.<sup>15</sup> This surgical maneuver makes sense in partisan/racial terms; it allows SSD16 to retain Black and Democratic neighborhoods while ditching whiter and more-Republican ones, thereby compensating somewhat for the loss of St. Petersburg (see Figure 3). The partisan/racial pattern is plainly visible. McCartan then drops back from that aggressive move to improve compactness, mostly by smoothing jagged edges on the northern end of the district (although he does tuck a bit of coastline into ACLU-B as well). Only with his final map does McCartan lop off the ACLU tendril, mostly kicking Ruskin out of the Tampa district, while allowing the coastline from Mangrove Point to Apollo Beach back in. By that point, though, he had extended the Tampa district’s boundary eastward to pull in Democratic territory south of the Hillsborough wilderness preserve – leaving other districts less compact, and the GOP vote still more diluted, relative to the enacted map (see Figure 4).



FIGURE 4 – How ACLU-C Expanded Eastward to Buffer the Tampa District’s Democratic Vote Share

### Enacted Map

ACLU-C



NOTE: The two shapes show how ACLU-C expanded the Tampa district (the border of which is illustrated by a dark line) to make up for losing Ruskin.

#### IV. A FOCUS ON AFRICAN-AMERICAN VOTING STRENGTH

- A. The enacted SSD16 map unites African-American neighborhoods from two portions of the Tampa/St. Petersburg/Clearwater Metropolitan Statistical Area, similar to the districting plans that mapmakers have been drawing around the country to avoid dilution of the Black vote. In this case, *Florida drew SSD16 in a context where African-American voting strength already had been diluted through erosion*. As Barreto's own report shows, in appendix tables 1-3 (pp. 19-22), African-American clout in the old SSD19 had declined from 2012-2020 across every measure. What his tables do not show, but my Table 4 displays, is that the enacted SSD16 did not group Black voters together more than would have been necessary to reverse that retrogression. Of the six indicators, four are still lower than they had been in 2012, and only one – the least meaningful – goes up much. The enacted Florida map stands in stark contrast to the ACLU's flagship scheme, which proposes accelerating the dilution of African-American voting strength in Tampa. For the ACLU-C map, the Black percentage declines across all six measures, taking them below the point to which they'd slipped. What I cannot say, because it is a legal question rather than a quantitative one, is whether such additional Black vote dilution is permissible.
- B. By restoring African-American voting strength closer to 2012 levels, Florida did not create an overwhelmingly African-American district, one that packs Black voters so much that their votes are wasted. Rather, Florida created an influence district that should amplify African-American clout. The SSD16 voting-age population (VAP) is only one-third Black (33.2% in DRA, 34% in the Barreto data), yet according to the provided data, African Americans make up a majority of the district's registered Democrats and fall just short of a majority among

TABLE 4 – The Enacted SSD16 Restored Black Voting Strength after It Had Been Diluted by Erosion

Black density in:	Share of Registered Voters		Share of General Election Turnout		Share of Primary Turnout	
	All Voters	Democrats Only	All Voters	Democrats Only	All Voters	Democrats Only
SSD19 in 2012	32.91%	52.44%	34.82%	54.74%	33.49%	55.34%
Enacted SSD16	32.96%	50.20%	31.27%	48.08%	35.33%	49.04%
ACLU-B's SSD16	30.42%	48.42%	29.55%	47.29%	33.19%	49.07%
ACLU-A's SSD16	30.39%	48.40%	29.51%	47.27%	33.15%	49.04%
SSD19 in 2020	30.09%	48.29%	28.65%	46.54%	32.86%	48.12%
ACLU-C's SSD16	29.27%	47.56%	28.16%	46.24%	31.44%	47.64%

NOTE: The numbers for SSD19 come from Barreto's report (tables 1-3, pp. 19-22), whereas the others come from our analysis of the provided data. Although our calculations for the old SSD19 were slightly different than his, they were so close that it seemed preferable for purposes of clarity to use the exact percentages appearing in his report.

Democratic primary voters, positioning them to elect their candidate of choice. Yet, based on the 2016-2020 composite, the district is safely Democratic, so even if the Black candidate of choice suffered significant defections from White, Hispanic, and other voters in a general election, that candidate should win. Such a process did not get to play out in 2022 because the incumbent, an African-American Democrat (Sen. Darryl Rouson), faced no intraparty competition. He did win handily in the general election that year.

- C. All three hypothetical maps furnished by McCartan have one thing in common: **The ACLU maps all crack the Tampa/St. Petersburg African-American vote into two separate districts.** Any time mapmakers want to split up the African-American vote in a Metropolitan Statistical Area, it ought to raise a red flag. These days, they usually engage in such manipulation for partisan reasons: Either Republicans are hoping to split up a Democratic cluster, preventing the Black population from swinging a district to the Democrats, or Democrats are trying to use the metro area to double dip, carving out two districts that emanate from the city and contain a Black minority as a Democratic anchor.<sup>16</sup> The latter might seem less pernicious, given the tendency of Black voters to support Democratic candidates in a general election regardless of their race or ethnicity. Still, **diluting the Black vote for partisan reasons sometimes will prevent African-American voters from electing their candidate of choice** – in the Democratic primary and/or in the general election. Let's see what the ACLU implicitly proposes to do in this case.
- D. We'll start with St. Petersburg. As discussed earlier, most African-American neighborhoods in Pinellas County currently appear in SSD16. So long as their preferences and interests coincide with those of Black neighborhoods in Tampa – that is, so long as Florida politics is characterized by racial polarization, as Barreto contends – then they have the numbers to dominate both the Democratic primary and the general election. The three ACLU proposals, however, consistently bump those voters into a district that solely covers south Pinellas County. The Black share of the SSD18 voting-age population goes from 6.4% in the enacted SSD18 to 12.63% in the ACLU maps. *Shifting more African-American voters into a South Pinellas District might help out Democratic prospects, but it almost doubles the number of Black voters likely to be prevented from electing their candidate of choice.* We do not need to look far for evidence to back up this supposition. Using the surface-level analysis that Barreto offers – one that simply looks at how previous vote totals were distributed in these places – we can see that **the Black candidate of choice would have lost the 2018 gubernatorial primary**

**in the “illustrative” SSD18.** Gillum, the candidate in question, received barely more than 30% of the primary vote in the version of SSD18 that the ACLU puts forward. Meanwhile, the district would remain only 52.3% Democratic, according to DRA. So **even if the Black candidate of choice somehow made it through the Democratic primary, any slippage among the district’s non-Black voters could cause a loss in the general election.**

- E. As long as Black voters in Tampa are assured of getting their preferred candidate in SSD16, one might not care about the African-American voters swallowed up by SSD18. What happens to Tampa’s Black vote once the linkage with St. Petersburg is broken? Mathematically speaking, African Americans would not be guaranteed to elect their candidate of choice in the enacted SSD16 even if they voted as a uniform bloc because, as Table 4 indicated, their share of the Democratic primary electorate just barely dips below majority (49%). The hold African Americans have over the district would weaken with the ACLU-C proposal (47.6%). Still, whether that near-majority would dominate Democratic primaries depends on the level of racially polarized voting: the extent to which African Americans remain unified, and the extent to which other voters coalesce against their preferences. Answering those questions requires more than just a simple vote count. It requires some form of ecological inference. I turn to that part of Barreto’s analysis next.

## V. ECOLOGICAL INFERENCE IN TAMPA AND ST. PETERSBURG

- A. **Barreto does little with ecological inference** for this case. A casual reader of his report might miss that fact, because he introduces the method in point 17 right after discussing the data he’ll be using for “performance analysis.” But Barreto does not use this sophisticated method of vote estimation in his performance analysis. Rather, for the performance analysis, he simply appears to be adding up past voting returns. We do not learn how his estimates for racially polarized voting would play out under the legislative maps.
- B. **The one conclusion Barreto uses ecological inference to reach in his report for this case is faulty**, inconsistent with the results he himself displays. Here’s what he writes in point 29: “...white voters in Hillsborough bloc vote against these Black-preferred primary candidates in each instance.”<sup>17</sup> But a casual glance at Barreto’s Figure 5 (pg. 27), shows that in the Attorney General race, White voters actually gave heavy support to the same African-American candidate



that Black voters favored (i.e., Shaw). I cannot say whether establishing racial polarization only requires finding evidence of racially cohesive voting in two of three contests; that's a legal question rather than a statistical one. Still, I conclude as a political scientist that Democratic primary voters in this region are not sufficiently polarized by race to shut African Americans out of the process.

- C. Barreto implicitly employs ecological inference in a second way: by appending an older report from a different lawsuit (see Barreto Appendix C). He uses the Florida-wide analysis reported in that external document to support his belief that racially polarized voting exists in the region of Florida implicated here, writing in point 27: "In this [older] report I found clear evidence of Black cohesion often above 90% in support of their candidate of choice. In contrast, white voters in Florida consistently voted in opposition to Black candidates of choice." Not having access to either the code or the analysis Barreto relies upon to insert a claim of racially polarized voting into the current case, I am left evaluating the quality of the code and the analysis that he did provide, taking them as illustrative.
- D. Based on the code and analysis provided, **Barreto applies a naïve version of ecological inference that does not adjust for known features of Florida's election data, with the result that his application of the method produces artificially confident estimates that are, in some cases, demonstrably wrong.** I will explain his departure from best practices in summary form, to give some explanation for why Barreto's analysis likely goes awry, but then shift to showing some of the imperfections that laypeople can recognize.
- E. Gary King's ecological-inference techniques assume that each social group included in the analysis votes more or less the same way everywhere. For example, if an analyst attempts to estimate support for a Democratic primary candidate by race, then the method will assume that White voters on average support the Black candidate of choice to the same extent everywhere. Of course, members of the group won't behave *exactly* the same way in each neighborhood, but EI assumes that such variation is random, with big differences improbable.<sup>18</sup>
- F. When such **assumptions fail to describe actual voting patterns within the data**, it interferes with estimation in two possible ways:
1. **Localized Bias:** If an analyst casts the net too wide in a single application of ecological inference, so that it's **combining members of**



**a group who have distinctly different preferences from each other, that can throw off the ecological inferences generated for that group in specific places.** For example, Barreto includes under the “Hispanic” label neighborhoods heavily populated by Cubans as well as neighborhoods heavily populated by Puerto Ricans – yet does not adjust the analysis to account for known political differences across those nationalities.<sup>19</sup>

2. **Overall Bias:** King’s techniques will be most inclined to generate inaccurate estimates when the voting behavior of social groups depends on the context where they live, such as if White support for the Black candidate of choice rises in places where they have more Black neighbors. **Ignoring contextual patterns in political behavior means that measures of racially polarized voting likely will be biased.**

3. Errors caused by incorrectly assuming common group preferences will be easier to catch in what Barreto calls Iterative EI, because simulation instability will be observable. For that reason, I focus on Iterative EI results in most of the analysis that follows.

G. One great virtue of Gary King’s solution to the ecological-inference problem is that it can produce fairly accurate estimates of a group’s voting behavior even in situations where the starting assumptions are wrong. Why? Because it uses two sets of numbers known exactly for small areas – the racial/ethnic makeup (from the Census Bureau) and the voting returns (from the state) – to generate estimates that are highly sensitive to what happens from place to place, and always mathematically possible. Problem is, Barreto does not perform his ecological inferences with units for which the voting returns are known. He’s using voting numbers built up from Census blocks, building up the sample size artificially, but votes aren’t counted at such a low level. **Barreto is using estimated data with an unknown amount of error to perform his ecological inferences.** The resulting estimates will be less accurate because of the measurement error, and the software will underestimate that error.

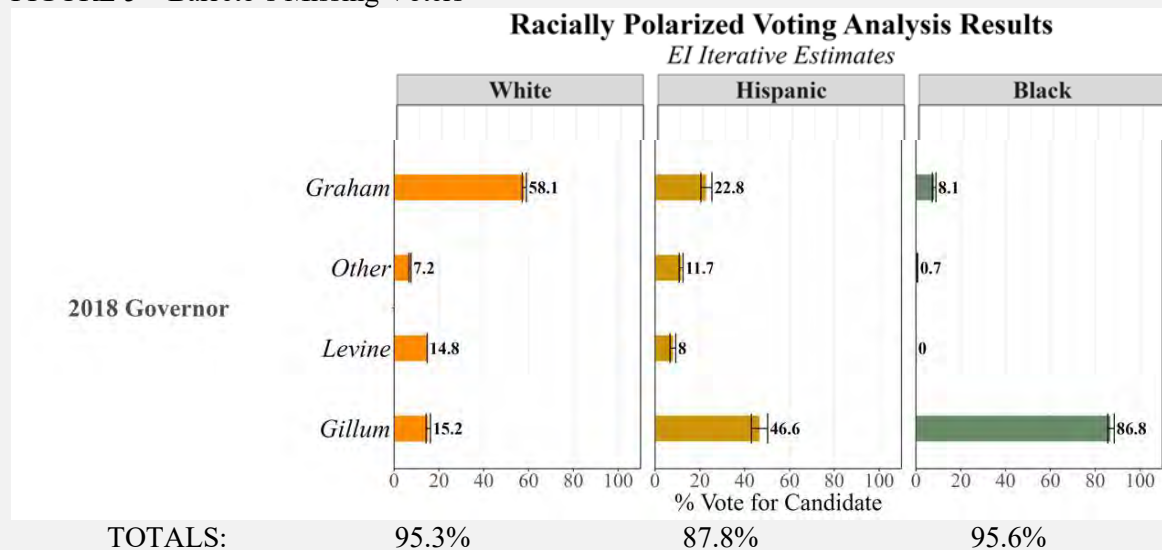
H. Judging from the code Barreto provided, his analysis does not take advantage of Florida’s high-quality turnout data; he performs and presents ecological inferences conducted using voting-age population. In his older report, Barreto claims that the choice of demographic data makes little difference,<sup>20</sup> an assertion I cannot evaluate outside of the metro area being analyzed here. But it definitely ought to make a difference when analyzing vote choice in a Democratic primary, as

Barreto attempts in the current report, because the race/ethnicity of primary voters can look very different from everyone who lives in a locale. **By using voting-age population data, when turnout data were readily available, Barreto injects instability and likely estimation error into his ecological inferences.**

## VI. EXPLORING THE ECOLOGICAL INFERENCE RESULTS

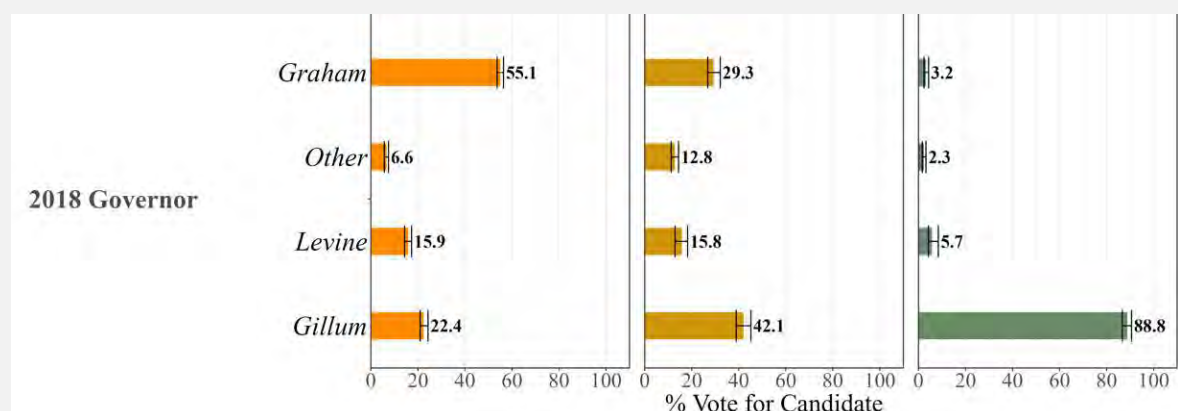
A. Let's start with an analysis as close as possible to what Barreto delivers (see Figure 5). It is his code (with bugs fixed), run on his data, for the same 2018 gubernatorial primary he analyzes. The results are not identical to the graph in Barreto's report, but fairly close. Compare to Barreto's Figure 5 (pg. 27). Both Barreto's version and

FIGURE 5 – Barreto's Missing Voters



NOTE: This graph purports to show how the three racial/ethnic groups distributed their support across all of the available candidates. If the estimates being simulated were accurate and reliable, the numbers in each box ought to sum to 100%, but they're all far off.

FIGURE 6 – The Two Approaches to EI Do Not Produce Stable Outputs

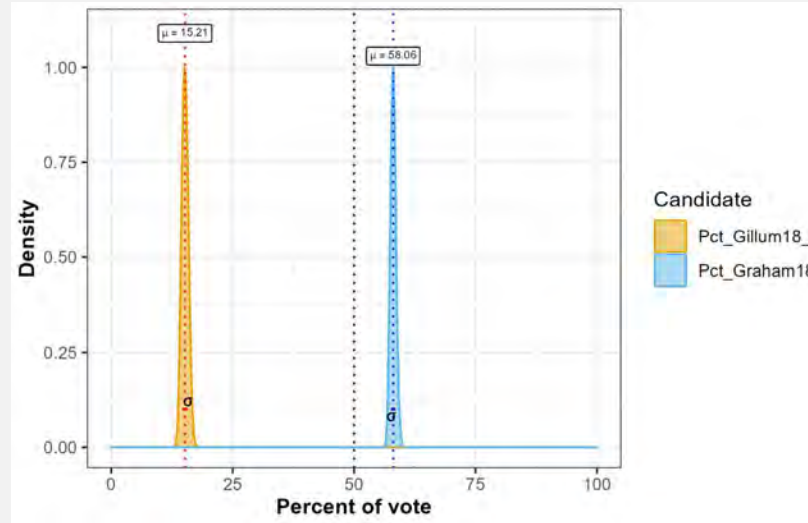


this replication reveal the same glaring problem: **The results cannot be close to accurate because they're impossible.** Iterative EI lost 4.4% of the Black vote, 4.7% of the White vote, and 12.2% of the Hispanic vote.

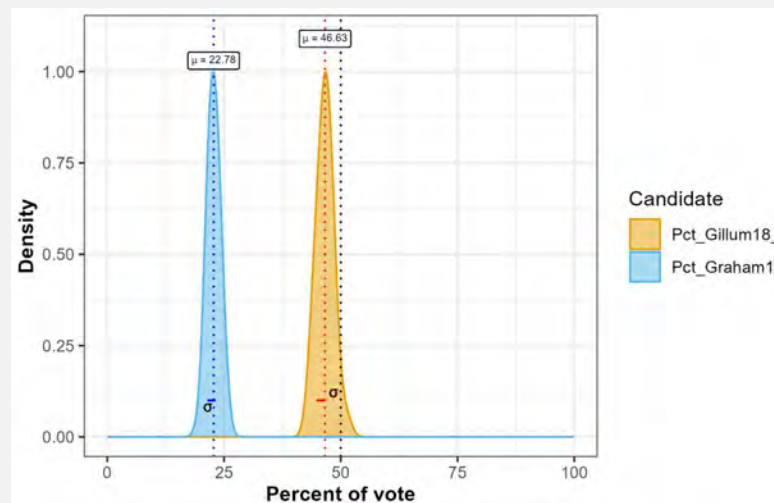
- B. The RxC EI will not reveal its errors so clearly. Still, if simulations are working well, results ought to show stability across variations in approach. That is not what Figure 6 shows. RxC EI didn't just allocate the missing voters; the estimated White support for Graham and Hispanic support for Gillum drops 3-4 points.
- C. Is the level of unreliability in Barreto's approach high? Yes, when compared to the level of uncertainty reported by the EI software he uses. The graph in Figure 7 displays visually the amount of error supposedly contained in the Iterative EI estimates. The graph shows two narrow spikes, for Whites and even Hispanics, meaning the software is much too confident in what has come out of this estimation. Figure 7a shows a standard error of only .004-.005, while the error for Hispanics is less than .02. The real gap between these approaches is much larger.
- D. The Hillsborough County results are downright reliable compared to what happens when we repeat the same analysis for Pinellas County. As Figure 8 illustrates, Iterative EI fails to account for an even larger share of voters in Pinellas. Results for two groups are worse, and while the African-American numbers are a bit closer to 100%, they also exceed that ceiling – usually a sign that aggregation bias has thrown off the estimation, exaggerating the amount of racially polarized voting.

FIGURE 7 – Errors from the Replication of Barreto’s Iterative EI

(a) White Voters



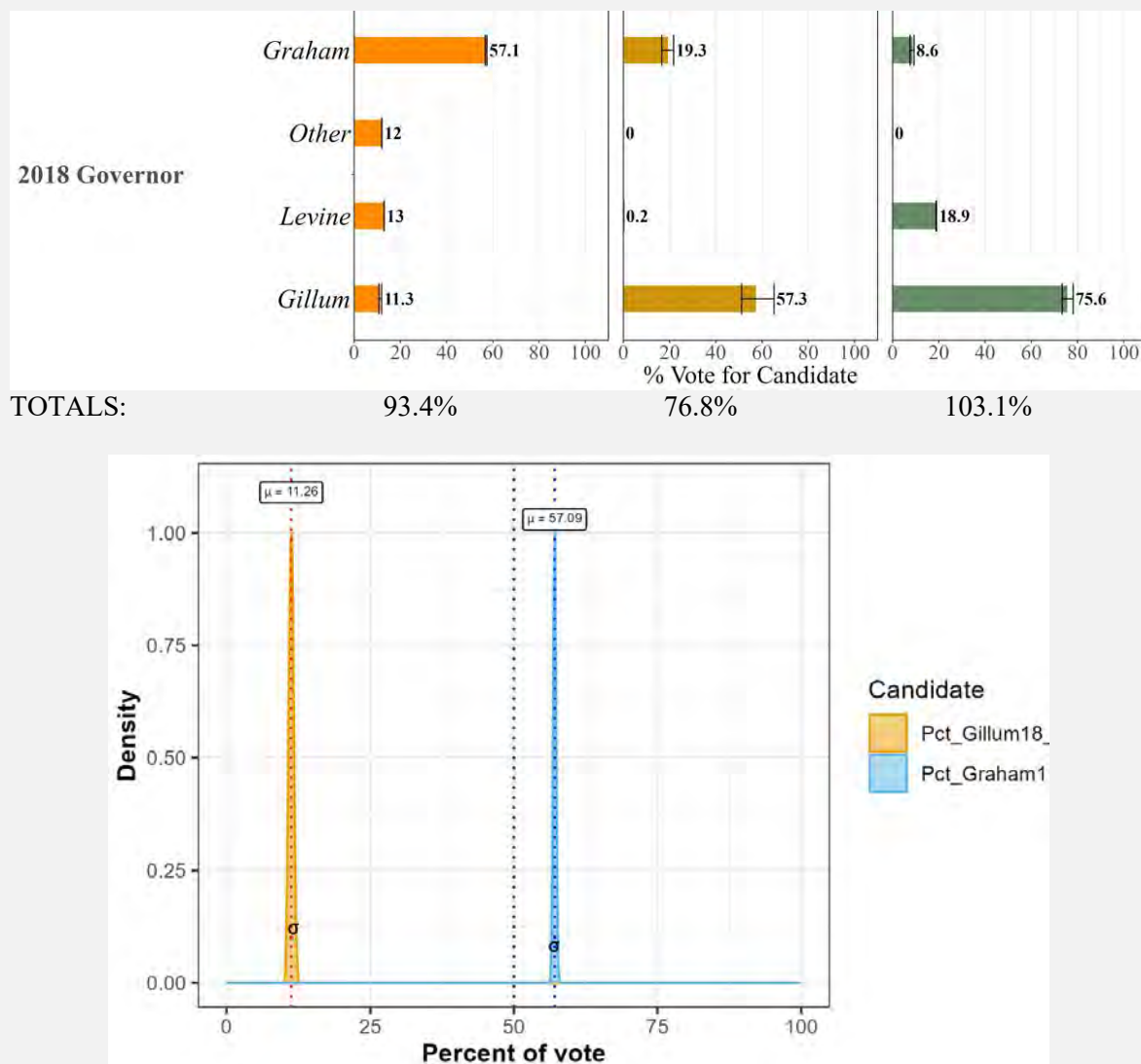
(b) Hispanic Voters



NOTE: The results from our Barreto replication are much too confident.

E. The data available to Barreto did not report turnout and voting only at the Census block level. Data also were available at the Census Block Group and the Census Tract level, each a larger unit of aggregation closer to the size of voting precincts. Insofar as the use of Census blocks artificially increases the number of supposed units available, and likely introduces more noise into the voting estimates, using larger units should cause some of that hidden error to wash out. So we repeated the 2018 gubernatorial analysis with those units. Using larger units does result in better-behaved ecological inferences in numerous

FIGURE 8 – Barreto’s Missing Voters in Pinellas County



NOTE: This graph purports to show how the three racial/ethnic groups in Pinellas County distributed their support across all of the available candidates. If the estimates being simulated were accurate and reliable, the numbers in each box ought to sum to 100%, but they’re all far off. The second graph shows the estimated error in the White vote, much smaller than warranted.

ways, as expected, and in both counties, the block-group analysis indicates the lowest level of racial polarization (see Table 5). The vote for Gillum goes from 86.8 vs. 15.2 in Hillsborough (a gap of 71.7 points), to 89.1 vs. 23.6 (a gap of 65.5) with block groups. In Pinellas, the shift takes the estimates from 75.6 vs. 11.3 when using Barreto units (a gap of 64.3) to 75 vs. 14.8 with block groups (gap of 60.2). The tract-level analysis is mixed, with polarization getting better in Hillsborough and worse in Pinellas. But the more-important observation is that changing numbers across these different areal units once again provides evidence of instability depending on the analysts



TABLE 5 – Racial Polarization Depending on Estimation Method

	HILLSBOROUGH						PINELLAS					
	Whites			Blacks			Whites			Blacks		
	Graham	Gillum	TOTAL	Graham	Gillum	TOTAL	Graham	Gillum	TOTAL	Graham	Gillum	TOTAL
Barreto Code	58.1	15.2	95.3%	8.1	86.8	95.6%	57.1	11.3	93.4%	8.6	75.6	103.1%
Barreto RxC	55.1	22.4	n/a	3.2	88.8	n/a	55.4	15.2	n/a	5.2	74.0	n/a
Block Groups	49.7	23.6	98.0%	4.2	89.1	105.8%	51.6	14.8	99.3%	6.7	75.0	104.2%
Tracts	50.7	21.0	97.3%	1.3	91.0	103.5%	52.1	14.0	99.2%	4.8	79.7	106.4%
Barreto Units	54.5	20.3	97.9%	6.9	82.3	95.8%	52.3	18.6	99.7%	9.7	70.5	100.4%
Block Groups	51.5	21.3	99.4%	8.2	74.9	101.6%	50.2	17.0	99.6%	10.2	67.1	101.6%
Tracts	52.3	19.0	98.8%	6.8	77.6	101.7%	50.5	16.2	99.3%	8.6	70.6	103.1%

NOTE: Iterative EI shows high instability depending on the unit of analysis used. The method improves the estimation of White and Black voting when using turnout data rather than voting-age population. TOTAL represents the summed support for all candidates; deviating significantly from 100% is a sign of estimation trouble.

methodological choices.

- F. Using racial/ethnic turnout data, instead of voting-age population, makes even more of a difference (again, see Table 5). Regardless of whether we conduct the ecological inference at the tract level, the block-group level, or the level of the smaller Barreto units, **the estimated amount of racially polarized voting drops when using turnout data**, true in both Hillsborough and Pinellas counties.<sup>21</sup> Specifically, estimated Black support for Gillum drops substantially when using the actual racial/ethnic turnout for the Democratic primary rather than using the entire VAP as Barreto did. **Using voting-age population apparently caused Barreto to overestimate the level of racially polarized voting.** I am baffled that he would switch to VAP when estimating voting in a Democratic primary, if in fact he used turnout when estimating voting in a general election (as claimed in Appendix C). The racial/ethnic mix of those voting in a party primary clearly will be more skewed, compared to the overall voting-age population, than the electorate in a general election. But lacking access to his code for the analysis reported in Appendix C, I cannot check to see whether the claim to have used turnout figures might have been made in error.

- G. The problem with forecasting likely district performance using a tract-level analysis is that State Senate districts split Census tracts. If we want a performance analysis for Senate districts, we need to derive estimates of racial/ethnic voting at a lower level and aggregate up to the areas of interest.<sup>22</sup> For that reason, we performed a small-unit analysis that could aggregate up to the Senate district borders, a process that we'd already tested by aggregating results up to other levels of aggregation (see Technical Appendix). This analysis is similar to the one run on Barreto units, but we use the superior turnout data and we isolate the portions of the two counties that moved from one Senate district to the next across the competing plans to get estimates specific to those moving parts.
- H. For purposes of using EI to inform a district performance analysis, I use the same gubernatorial primary as Barreto: the 2018 Democratic gubernatorial primary. Table 6 shows the expected performance for two versions of SSD16, the one from the Enacted map and the one from the ACLU-C plan. A change in territory from the enacted to the ACLU-C map would alter the mix of Black and other voters, such that African Americans in 2018 were less likely to defect from unity while both White and Hispanic voters gave the Black candidate of choice a lower share of their vote. Putting the two differences together, racial polarization would increase in the illustrative SSD16 compared to the current district.
- I. Why would splitting the enacted SSD16, and stuffing part of it in SSD18, increase racial polarization? Because voters show less racial polarization in that portion of St. Petersburg than found in the relevant portions of Hillsborough County. The area that shifts across those districts included White voters who gave Graham an estimated 49% of their support, and Gillum 24.6% -- lower polarization levels than found for the counties as a whole -- and similarly moved African-American voters who appear to be less lopsided toward Gillum. The

TABLE 6 – The ACLU-C Map Slightly Increases Expected Racial Polarization in SSD16

	Whites			Blacks			Hispanics		
	Graham	Gillum	Gillum%	Graham	Gillum	Gillum%	Graham	Gillum	Gillum%
Enacted	49.6	25.7	34.1	8.1	77.9	90.6	38.2	36.6	48.9
ACLU-C	50.5	25.0	33.1	7.2	82.6	92.0	37.8	35.5	48.4

NOTE: Shows the results of the ecological inference in Table 6, with the units aggregated up to the SSD16 in the enacted map and the SSD16 in the ACLU-C plan.

ACLU's illustrative additions to SSD16 pull in a more polarized population.

- J. Having SSD16's Black population decline in ACLU-C, and replacing that Black population with Whites and Hispanics more likely to engage in racially polarized voting, raises the question of whether the ACLU-C version of SSD16 would threaten the ability of Black voters to elect their candidate of choice. If all three groups turned out at comparable rates – if the electorate looked like the voting-age population (44.37% White, 30.02% Black, 25.61% Hispanic), Black voters would lose. Using the Gillum proportions in Table 6, support for the candidate of choice is  $(44.37 * .25) + (30.02 * .826) + (25.61 * .355) = 44.98$ . That's lower than the vote for Gillum based on the enacted SSD16, which is  $(45.02 * 0.257) + (33.2 * 0.779) + (21.78 * 0.366) = 45.40$ . If Black voters were 48.8% of the primary vote, as per ACLU-C in Table 4, then at this rate of defection, they'd only get Gillum up to 40% of the vote, meaning that the Black candidate of choice would need to rely on voters of other race/ethnicity to reach majority support. While it's true that, if everyone else supported the Black candidate of choice at the rates seen in Table 7, that candidate would prove victorious, the expected outcome leaves only a modest cushion (perhaps 5 percentage points). Greater mobilization by White and Hispanic voters against the Black candidate of choice could be effective.

## V. CONCLUSION

- A. I was asked to critically evaluate the McCartan and Barreto reports, so my emphasis has been on the imperfections and potential errors in what those two consultants submitted. For that reason, the differences between my report and theirs might appear greater than they are. It should assist the Court, therefore, if I conclude by underscoring the similarities.
- B. Plaintiffs' experts and I agree that McCartan has been able to construct a few plans worse for Republicans than the one Florida enacted, and that one version of SSD16 (the one in ACLU-C) improves on the compactness of SSD16 (albeit by making two districts, SSD20 & SSD23, less compact).
- C. Plaintiffs' experts and I agree that McCartan's "illustrative" maps are able to crack the Black vote in Tampa-St. Petersburg without necessarily preventing African Americans from electing their candidate of choice in all of the resulting districts. Black voters are weakened in the ACLU's proposed SSD16, and more vulnerable to racial bloc voting by Whites

- and Hispanics – but, judging from voting in the 2018 Democratic primary, White and Hispanic voters support the Black candidate of choice at sufficiently high rates for that politician to win. Racially polarized voting would need to increase to deny African Americans their dominance over SSD16.
- D. Barreto and I both implicitly agree that Gary King’s solution to the ecological-inference problem is the best available method for estimating racially polarized voting. I take issue with how Barreto implemented King’s techniques – his use of Census blocks, his use of VAP instead of primary turnout, and his decision to use naïve ecological inference instead of adjusting for known patterns in how social groups vote – but we still agree in broad brushstrokes that (1) Black voters engaged in clear racial-bloc voting in three primaries featuring an African-American candidate, with a supermajority backing the Black candidate, and (2) although White and Hispanic voters showed less racial cohesiveness, they did side against the Black candidate of choice in two of three contests. No one denies racial/ethnic identity still shapes voting behavior in Florida, although Barreto systematically overestimates it.
- E. In sum, the enacted SSD16 is unremarkable. It maintains the core of the district it replaced, and remains within an economic community of interest. It is reasonably compact and, by holding together Black neighborhoods in Tampa and St. Petersburg, it reverses erosion of Black voting power since 2012. It promises to produce, on average, a state-senate delegation from the area consistent with area partisanship. The alterations supported by Plaintiff’s experts would improve Democratic fortunes, a shift that would dilute both the Black and the Republican vote – not a clear improvement.

### Certification

The opinions expressed above are sworn, under penalty of perjury, to be true and based on the facts and criteria available to the expert witness as of the time of this report. This expert reserves the right to supplement this report as new information becomes available or as requested by the Plaintiffs.

Signed this 9th day of September, 2024.

Name: Dennis G. “Stephen” Voss, Jr. (aka D. Stephen Voss) *D Stephen Voss*  
Expert Witness

## TECHNICAL APPENDIX: HOW EI WORKS AND HOW BARRETO APPLIES IT

Voting by secret ballot complicates any attempt to assess the demographic implications of legislative districts. We know how a locale voted, and we know the racial/ethnic makeup of the place, but we do not know the cross-tabulation between those two things; we cannot measure directly how voting differed by race and ethnicity.

In some places, that ignorance is broad. Several steps in the electoral process might be hidden: racial/ethnic differences in voter registration, racial/ethnic differences in whether registered voters showed up to cast a ballot, not to mention what happens with those ballots. In especially data-rich environments like Florida, on the other hand, we know the race/ethnicity and the party registration of those going into the voting booth.

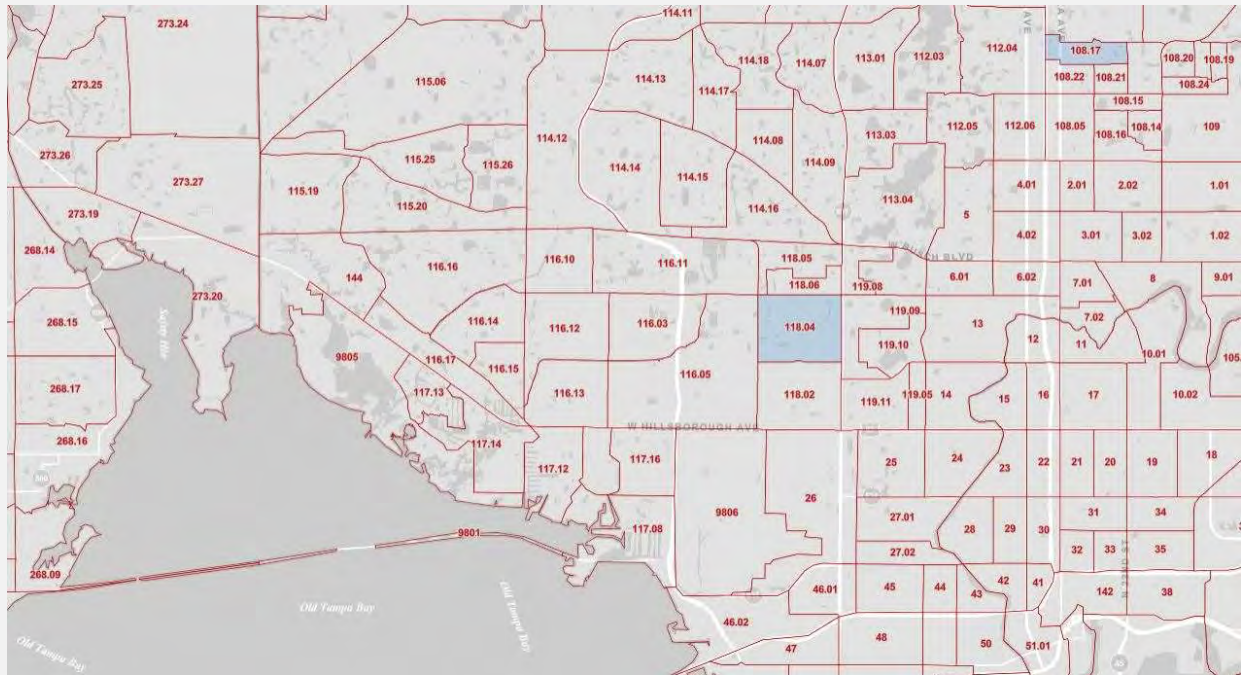
Still, we cannot follow voters into the booth, and we have no way to aggregate their choices by race and ethnicity. Even in the best of circumstances, therefore, an analyst is stuck trying to infer how race/ethnicity crosstabulates with vote choice – that is, how social groups differed in their voting behavior. We might know that 49.04% of SSD16 residents who voted in the 2018 Democratic primary were African American, and we might know that Gillum won 53.3% of the primary vote in that area, but we can only estimate what percentage of Black voters picked him versus picked one of his opponents, and we’re stuck guessing how everyone else voted as well. Notice the implication for voting-rights cases: The level of racially polarized voting – the gap between races in how they voted – can never be known factually. It can only be estimated using quantitative methods. Attempting to estimate those hidden quantities goes under the jargon “ecological inference.”

Gary King’s techniques for that purpose do not start out by estimating what’s happening across the entire area (for example, the entire county) being analyzed. Instead, the method starts with smaller units, such as precincts or the units Barreto created, and takes advantage of inputs the analyst *knows to be true* – the population demographics (from the Census) and the election returns (from the state’s election authority) – to restrict what it can guess for each little unit.

I will illustrate using a pair of Census tracts in Hillsborough County: 118.04 and 118.17. Their locations, relative to the north of Tampa Bay, appear in in Figure A.



FIGURE A – Forcing Ecological Inferences to be Mathematically Possible: Two Sample Census Tracts



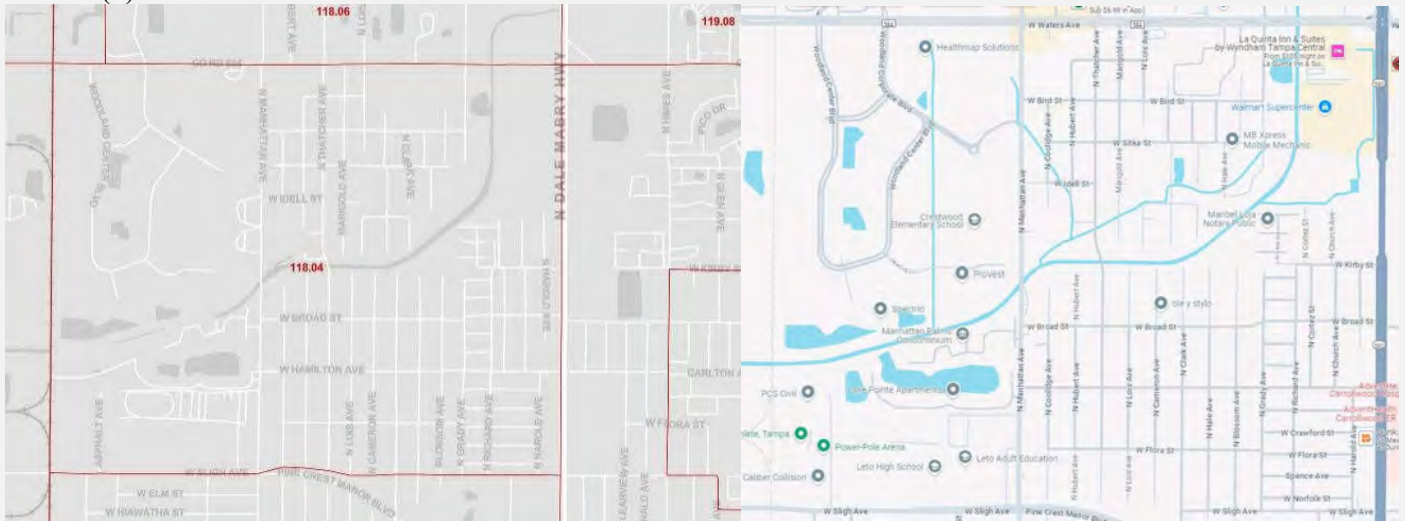
Hillsborough tract 118.04 appears as Figure B1, which has the Census Bureau map on the left and the Google map for the area on the right. It contained 4,564 adults at the time of the 2020 Census, of whom 3,524 were Hispanic. Most of that Hispanic population, more than  $\frac{3}{4}$  of it, reported Cuban nationality. Perhaps for that reason, Hispanic voter registration only slightly tilts toward the Democratic Party in the tract. The political data accompanying Barreto’s report suggest that the tract’s Cuban residents were not as mobilized in 2020 as others living there; only 1,191 of the 2,045 people who turned out to vote apparently were Hispanic. The tract backed Donald Trump’s presidential candidacy 55% to 45%.

Table A presents the inputs that would go into ecological inference for this tract, expressed both as counts and as proportions, and shows as question marks the crosstabulations we might need to know: how Hispanics voted, and how everyone else did. Here’s how King’s method ensures that estimates will be mathematically possible for each of these little units, a process called the **method of bounds**:

Trump received 1,129 votes, but only 854 non-Hispanic voters turned out, so Trump’s Hispanic support there could not have been 0%. At a minimum, he picked up  $1,129 - 854 = 275$  Hispanic votes. That is, at least  $275/1,191 = 23.1\%$  of Hispanic voters backed Trump. At the same time, more Hispanics showed up than Trump received votes in the tract, so Trump could not have received 100% of the Hispanic vote; at least  $1,191 - 1,129 = 62$  Hispanic voters must have picked Biden, even if not a single non-Hispanic backed Trump.

FIGURE B – A Cuban Census Tract and a Puerto Rican One

(1) Tract 118.04



(2) Tract 108.17

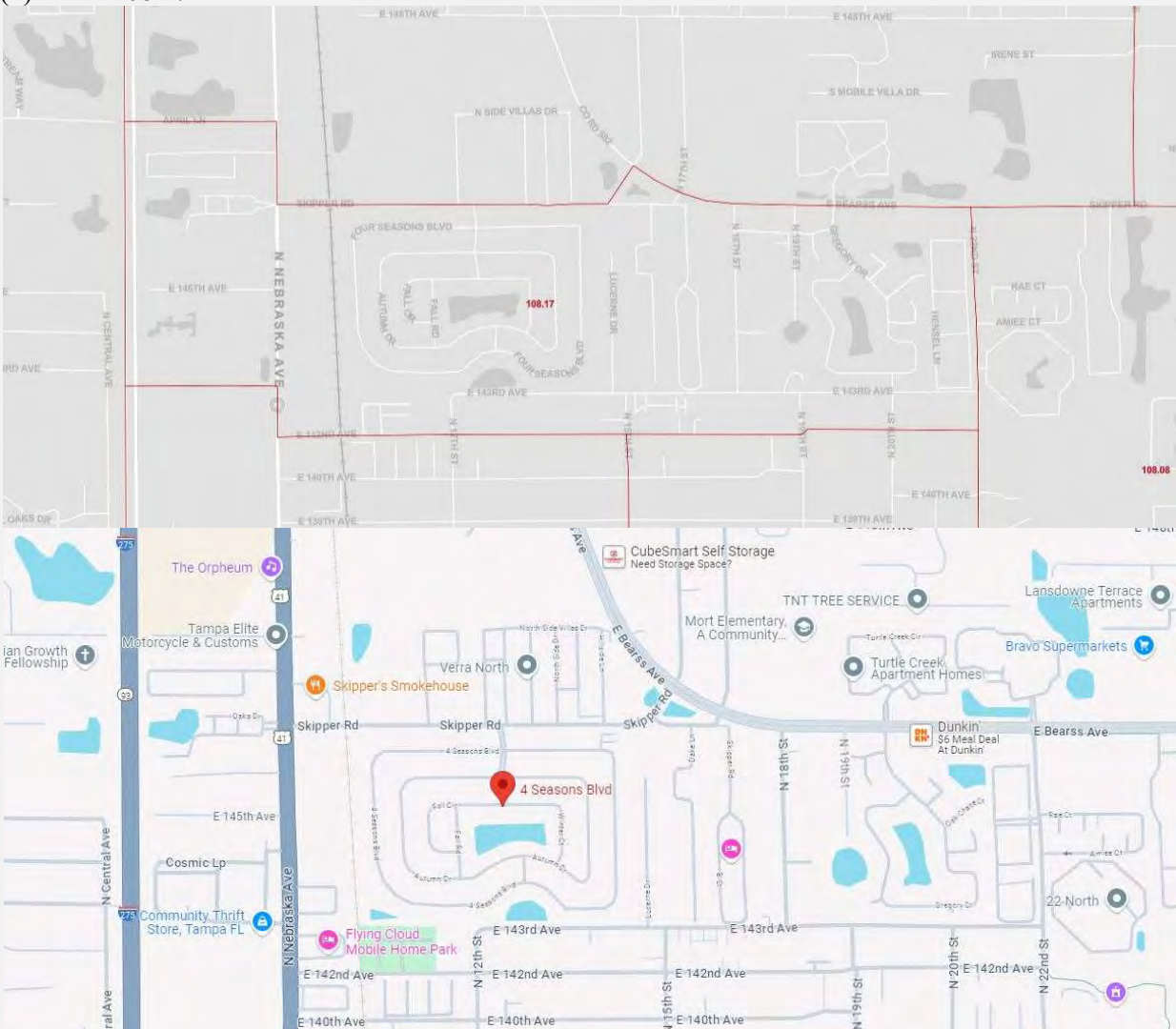


TABLE A – The Method of Bounds in a Heavily Cuban Precinct

Hillsborough 118.04			
	Hispanic	Non-Hispanic	
Biden	?	?	916
Trump	?	?	1129
	1191	854	2045
Hillsborough 118.04			
	Hispanic	Non-Hispanic	
Biden	?	?	0.45
Trump	?	?	0.55
	0.58	0.42	2045

We cannot narrow down, in the same way, how non-Hispanic voters behaved. Anything from 0% Trump support to 100% Trump support would be mathematically possible here. Yet we still know a lot about how those non-Hispanic voters could have behaved because once we know Trump's rate of Hispanic support, then one and only one rate of non-Hispanic support would be possible mathematically. That is, the support for Trump is linear:

$$\begin{aligned} \text{Trump Vote} = & \text{Hispanic Turnout} \quad \times \text{Rate of Hispanic Vote for Trump} \\ & + \quad \text{Non-Hispanic Turnout} \quad \times \text{Rate of non-Hispanic Vote for Trump} \end{aligned}$$

We know the two turnout rates in the tract, and once we hypothesize a particular level of Hispanic support, then the corresponding level of non-Hispanic support would be computed this way:

$$\text{Non-Hispanic Rate} = (\text{Trump Vote} - \text{Estimated Hispanic Votes for Trump}) / \text{Non-Hispanic Turnout}$$

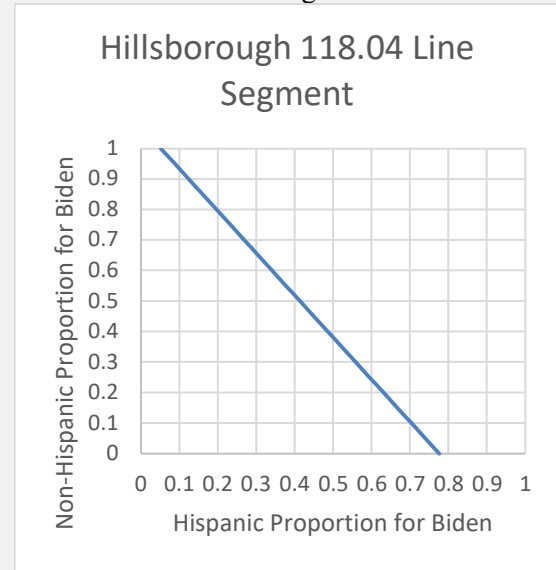
Obviously neither of these rates can fall below 0% or go higher than 100%, so if we were going to graph what's possible for this particular Census tract, the result would be a line segment rather than a line. The line segment for Hillsborough tract 118.04 appears in Figure C, illustrating possible rates of support for Biden rather than Trump. The location of that line segment indicates what we've already determined from simple calculations: Because the line segment extends from top to bottom, the non-Hispanic rate of support for Biden can range from 0 – 100%, whereas the line segment does not extend from left to right – showing that Biden's Hispanic support could not have been greater than  $100 - 23.1 = 77.9\%$  (because that's the farthest right that the segment reaches), but also was not zero (because the left-hand side of the segment never reaches the left-hand side of the box).

Because what's possible for each group depends on the size of that group in the unit's population, with our certainty about how the group voted depending on the relative



size of the group, the slope of the line segment also tells us which racial/ethnic group is most numerous in the locale. A line that is either vertical or horizontal is homogenous; we know precincts how one group voted but have no idea about the other group. A locale that's almost equally balanced between the two groups, as Hillsborough 118.04 was balanced between Hispanics and non-Hispanics, will cut diagonally across the box, because either group could have given high or low support to the candidate. We know a lot less about tracts such as this one. But the true combination of Hispanic and non-Hispanic support for Biden appears somewhere on that line segment, and when King's method tries to estimate what those rates were, it will only pick a spot somewhere along that segment.

FIGURE C – Hillsborough 118.04



The second sample Census tract, 108.17, appears as Figure B2. This tract also contains a large Hispanic population, but of Puerto Rican rather than Cuban descent – a group with stronger ties to the Democratic Party. Table B shows why we will have a much easier time estimating political behavior in this tract, compared to the last. Joe Biden received 798 votes here (or 83%). Even if every Hispanic cast a vote for Biden, at least  $798 - 416 = 382$  non-Hispanics (or 70.3% of them) must have sided with him. Even if every non-Hispanic backed Biden, at least  $798 - 543 = 255$  (or 61.3%) of Hispanics must have backed him. So even though the line segment for this tract will be angled about like the last one, because the population is fairly evenly balanced like in the last one, we're still going to be

TABLE B – The Method of Bounds in a Heavily Puerto Rican Precinct

Hillsborough 108.17

	Hispanic	Non-Hispanic	
Biden	?	?	798
Trump	?	?	242
	416	543	959

Hillsborough 108.17

	Hispanic	Non-Hispanic	
Biden	?	?	0.83
Trump	?	?	0.25
	0.43	0.57	959

able to narrow what's mathematically possible to a much greater extent here because of the very high level of Biden support. Biden did so well that both groups had to support him at high levels. Figure D shows the line segment that captures all of the possible combinations of Hispanic and non-Hispanic support for Biden that would be mathematically possible in this tract. And we've done all of this narrowing down without estimating, guessing, or assuming a single thing so far.

If we combine all the line segments for every single tract in an analysis into a single box – that is, if we collect everything that's mathematically possible for each tract in one place – we get what King calls a **tomography plot**. An experienced EI user, who has looked at a lot of tomography plots and analyzed a large variety of datasets, can tell a lot about whether ecological inference is likely to work – and what problems might plague it

FIGURE C – Hillsborough 108.17

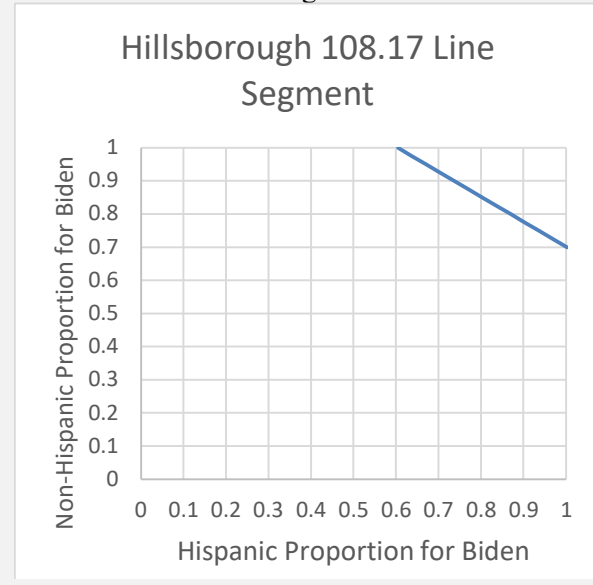
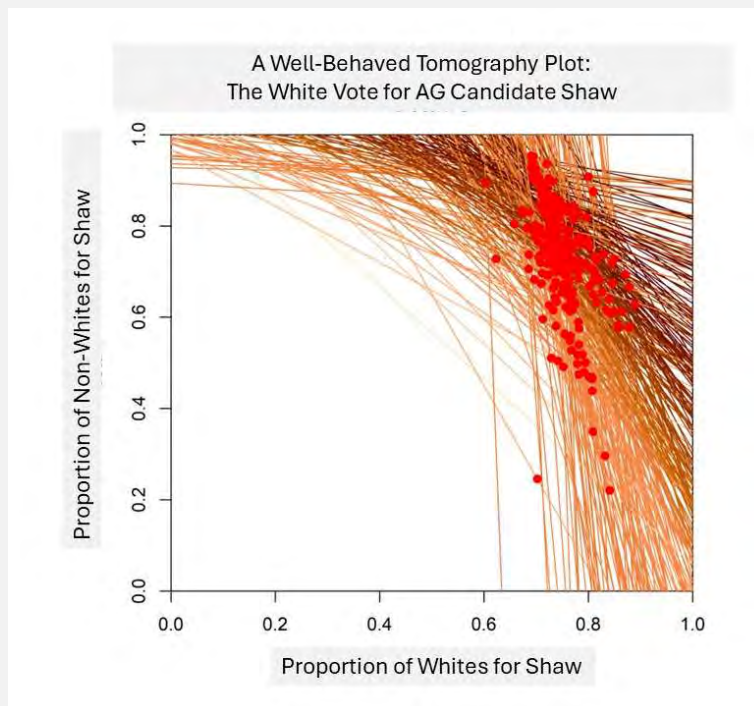


FIGURE D –



NOTE: The horizontal, lateral, and vertical lines all tend to converge around the same spot in the upper-right-hand corner of this tomography plot. For that reason, it is fairly easy to identify the region of the square where the combination of White and non-White candidate support is most likely to appear.



– from the visualization of all those line segments.

For example, FIGURE D shows a tomography plot for White voting behavior at the tract-level, when using racial/ethnic turnout data, for the 2018 Democratic primary contest between Shaw (the Black candidate of choice) and Torrens. Each line segment represents one tract in Hillsborough County, with each tract's true combination of White and non-White support for Shaw appearing somewhere on the line segment associated with that tract. In this case, because the line segments – horizontal, lateral, and vertical – all appear to be passing through roughly the same section of the unit square, EI will not have a hard time inferring support rates. The red dots represent the best guesses for each line segment, with most of them clustered where the line segments are coming together.

Once King's method picks a spot on each of these line segments, with each spot representing a mathematically possible level of combined White and non-White support for Shaw, those tract numbers are added up to represent an estimate for how Whites and non-Whites voted in the whole county. Because the county-level estimate builds from a whole series of tract-level estimates that are mathematically possible, the method's guess for what happened in the county also will be mathematically possible. Indeed, because each step has been disciplined by the method of bounds – because all the guesses are bounded by what each tract tells us about what is and is not possible – then the method sometimes can perform well even when some of its underlying assumptions are not met.

That voting in a smaller unit can be reduced to a line segment is only one assumption that King's method makes. King's method also makes a simplifying assumption to help with deciding where to on the line segment a unit's voting rates are likely to appear. He assumes that each group has the same basic underlying political preferences everywhere being analyzed, give or take the usual randomness in human behavior. African Americans will have some typical level of support for Gillum, although it might pop higher or lower randomly in any given precinct. The same can be said for Hispanics and White/Other voters: They have a basic lean, but it'll jiggle a bit from precinct to precinct. That is why it was important, in the last tomography plot, to see the various line segments converging in roughly the same location. Where that spot appeared along the two axes would be EI's guess for the two underlying rates of group behavior. Trying to make ecological inferences when that assumption is faulty, though, can blow up the estimation unless the method of bounds forces the estimates back to reality or unless the analyst actively captures the diversity within the group being studied.

King's method can be even more vulnerable to error if the differences in a group's voting behavior are not random. As mentioned earlier, King's method derives estimates for the larger unit (such as the county) using the information available in smaller units (such as tracts or precincts). Those smaller units might be

fairly diverse. Some might be overwhelmingly Black, others overwhelmingly White, others overwhelmingly Hispanic. The vote percentages might vary across those places as well, with some units heavily supporting one candidate while others heavily support a different candidate. By looking at how the vote choice varies with a place's demographic composition, we can guess how different groups might be voting. If we notice that Gillum's support tends to grow as the little units have higher Black density, for example, then we'll infer that African-American voters tended to back Gillum. A third assumption King's method makes is that voting by one group does not depend, directly or indirectly, on the size of the other group. The patterns EI uses to estimate voting rates can be misleading, though, if how a group behaves depends on who lives around them. If Whites living in heavily Black neighborhoods vote differently than Whites in heavily White areas, then that can throw the estimation.

Naïve ecological inference, conducted with no regard for such contextual patterns, can introduce "aggregation bias" into the estimation – not just getting the results wrong in certain places, but getting the wrong results for the whole area being studied. In particular, if Whites or Hispanics show greater Democratic support in mixed-race areas than they do in homogenous ones – for example, if urban Hispanics and Anglos are more Democratic than rural and small-town ones – the bias will be toward making racial polarization seem greater than it actually is.

Armed with this deeper understanding of how King's solution to the ecological-inference problem works, it is now possible to explain in more technical terms why Barreto's analysis would go awry. Barreto runs up against each of the three potential problems implied just now. Barreto does not employ ecological inference in a reliable fashion consistent with best practices, and each of the three difficulties faced by his analysis can be expressed in terms of tomography plots.

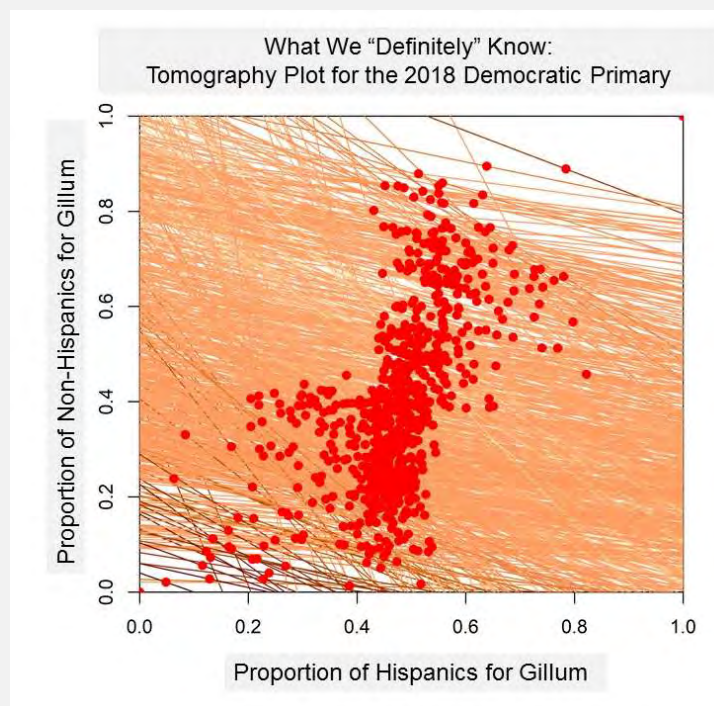
First, although in most instances of ecological inference, a low-level unit could be represented by a line segment, the tomography plot wouldn't capture what's possible for Barreto's analysis. He's using Census blocks partitioned in multiple ways and then grouped: first by county, then by Census place (similar to a "municipality"), then by Census tract, then by voting-tabulation district (VTD, similar to a precinct), and finally divided up by the enacted State Senate district where it falls. This complex unit of geography has no name or intuitive meaning, so I've just been calling them "Barreto units." What's troublesome about these Barreto units is that we don't actually know the political behavior of the Census blocks used to create them. Votes aren't counted by Census block. All we have are guesses as to how those blocks voted, created by projecting election returns down to that level. And we have no way to know how messy those projections are. So when Barreto's ecological inference attempts to use the method of bounds to restrict his estimates to what's mathematically possible, he's not actually feeding things we "definitely know" into the system. He's feeding estimates with an

unknown amount of error into the system. The only reason those Barreto units can show up in the tomography plot as line fragments is because he's ignoring that error and treating the numbers as truth. Not only will the resulting ecological inferences be less accurate, because of the measurement error, but the software will attach greater certainty to its ecological inferences because it doesn't know it was fed bad data.

Now the second assumption. If it's true, as assumed, that the two groups in an ecological inference each have a common underlying level of support level for the candidate across the entire county, then the line segments should tend to crisscross near the spot representing those two values, the way they did in Figure D. Instead, as seen in Figure E, the tomography lines for Hispanic voting in the 2018 gubernatorial primary do not converge on a particular space in the unit square. The analysis is combining heavily non-Hispanic units that are mostly White – they will tend to be the horizontal lines near the bottom of the square – with heavily non-Hispanic locations that likely are heavily Black and appear as horizontal lines near the top of the square. Non-Hispanics do not at all vote in a similar way across the county!

Meanwhile, the lack of vertical or even especially slanted line segments in Figure E tells us that the data do not provide much information about Hispanic voting. What we can see from the mass of red dots in the center is that EI, assuming that all Hispanics tend to vote the same way everywhere, keeps offering Gillum support of around 45% as the best guess for each unit. For the Barreto units

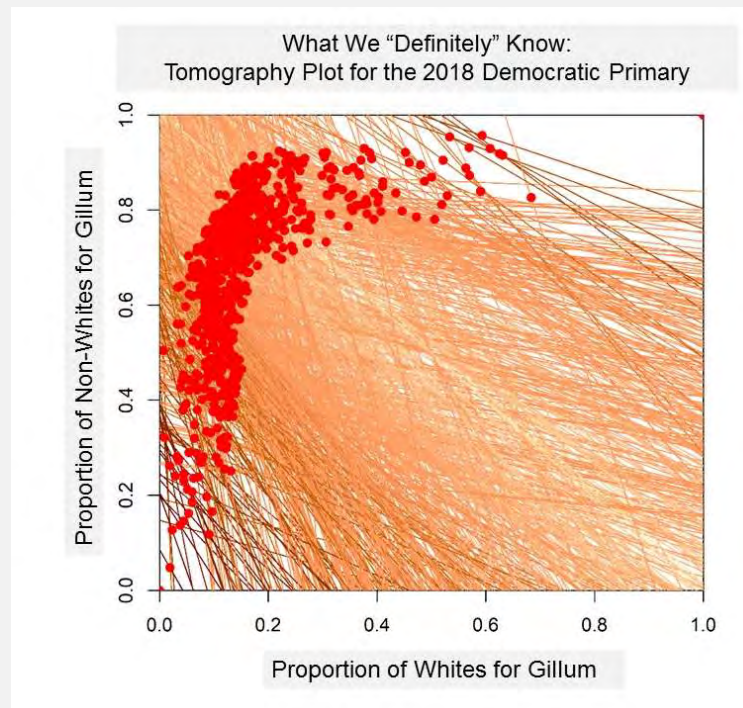
FIGURE E –



where we don't know a lot about Hispanic voters because they're small in number, ecological inference keeps guessing roughly the same thing. Yet Florida's Hispanic population includes both Cubans and other Hispanics (including Puerto Ricans, Mexicans, and Venezuelans). No one seriously would propose that those groups all exhibit the same underlying political behavior. And we can see from the tomography plot that actual Hispanic behavior is much more varied than EI generally assumes. Why? Because in the few places where the method of bounds forces estimates away from the middle, we see two clusters: one on the bottom left, and another toward on the top right. Because the assumptions of the model are wrong, we're likely to see instability in estimates of Hispanic voting, which in turn will mean that estimates for Black and White voting will be less accurate than necessary to guess how district lines actually will perform. And indeed, estimates of Hispanic support for Gillum varied so widely that I didn't even bother to include them in Table 5. They ranged from heavy support for the Black candidate of choice all the way to negligible support for that candidate.

Now, it's true that both versions of EI that Barreto uses – Iterative EI and RxC EI – would be estimating separately how Blacks and Whites voted. To the extent it can get those numbers right, the analysis could adjust for the messiness of the Hispanic analysis. But Figure F shows another sign that the ecological inferences are likely to be sloppy, one that might contaminate White and Black estimates as well. Figure F offers a tomography plot from the same 2018 Democratic primary, but this time focused on White voters. Once again, the line segments are not mostly crisscrossing in one spot. And once again, the red dots

FIGURE F –





show that how a group votes likely depends on the size of the other group. The way the red dots sweep up and then rightward tells me that White voters differ by the racial context of their neighborhood, the sort of pattern that can cause aggregation bias unless taken into account. As we move upward in the square, likely moving toward units with a heavier African-American presence, it appears as though White support for Gillum increases as well, because the red dots start drifting rightward. To some degree, ecological inference likely is attributing that changing White behavior to their Black neighbors. That's the aggregation bias.

A final note. To test what happens when we use low-level units to estimate voting behavior, but then aggregate up to the Senate district level, we tried that approach using block groups and tracts. The rows added to Table 5 here show that the results aggregated up to those levels are fairly close to what EI returned when directly estimating the vote at those higher levels. The aggregation process works fairly well.

TABLE 5 – Racial Polarization Depending on Estimation Method

	HILLSBOROUGH						PINELLAS					
	Whites			Blacks			Whites			Blacks		
	Graham	Gillum	TOTAL	Graham	Gillum	TOTAL	Graham	Gillum	TOTAL	Graham	Gillum	TOTAL
Barreto Code												
Barreto Rx C	58.1	15.2	95.3%	8.1	86.8	95.6%	57.1	11.3	93.4%	8.6	75.6	103.1%
	55.1	22.4	n/a	3.2	88.8	n/a	55.4	15.2	n/a	5.2	74.0	n/a
Block Groups												
Tracts	49.7	23.6	98.0%	4.2	89.1	105.8%	51.6	14.8	99.3%	6.7	75.0	104.2%
	50.7	21.0	97.3%	1.3	91.0	103.5%	52.1	14.0	99.2%	4.8	79.7	106.4%
Barreto --> BG's												
Barreto --> Tracts	52.1	24.2	99.2%	4.4	91.2	102.7%	55.2	15.4	100.0%	5.3	76.4	101.6%
	53.2	21.1	97.9%	1.4	92.6	101.7%	55.5	14.5	99.3%	3.6	82.0	104.3%
Barreto Units												
Block Groups	54.5	20.3	97.9%	6.9	82.3	95.8%	52.3	18.6	99.7%	9.7	70.5	100.4%
Tracts	51.5	21.3	99.4%	8.2	74.9	101.6%	50.2	17.0	99.6%	10.2	67.1	101.6%
	52.3	19.0	98.8%	6.8	77.6	101.7%	50.5	16.2	99.3%	8.6	70.6	103.1%

NOTE: Iterative EI shows high instability depending on the unit of analysis used. The method improves the estimation of White and Black voting when using turnout data rather than voting-age population. TOTAL represents the summed support for all candidates; deviating significantly from 100% is a sign of estimation trouble.

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[https://www.researchgate.net/publication/376798358\\_Familiarity\\_Doesn't\\_Breed\\_Contempt\\_The\\_Political\\_Geography\\_of\\_Racial\\_Polarization](https://www.researchgate.net/publication/376798358_Familiarity_Doesn't_Breed_Contempt_The_Political_Geography_of_Racial_Polarization)

<sup>2</sup> Voss, D. Stephen. 1996. "Beyond Racial Threat: Failure of an Old Hypothesis in the New South." *Journal of Politics* 58:1156-70.

<sup>3</sup> For example, Lublin, David, and D. Stephen Voss. 2000. "Racial Redistricting and Realignment in Southern State Legislatures." *American Journal of Political Science* 44(October):792-810.

<sup>4</sup> King, Gary. 1997. *A Solution to the Ecological Inference Problem: Reconstructing Individual Behavior from Aggregate Data*. Princeton, NJ: Princeton University Press. Pp. xxii, 22-24.

<sup>5</sup> Voss, D. Stephen. 2004. "Using Ecological Inference for Contextual Research: When Aggregation Bias Is the Solution as Well as the Problem." In Gary King, Ori Rosen, and Martin Tanner (eds.), *Ecological Inference: New Methodological Strategies*. New York: Cambridge University Press. Pp. 69-96.

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[https://www.researchgate.net/publication/376798358\\_Familiarity\\_Doesn't\\_Breed\\_Contempt\\_The\\_Political\\_Geography\\_of\\_Racial\\_Polarization](https://www.researchgate.net/publication/376798358_Familiarity_Doesn't_Breed_Contempt_The_Political_Geography_of_Racial_Polarization)

<sup>7</sup> Voss, D. Stephen, and David Lublin. 2001. "Black Incumbents, White Districts: An Appraisal of the 1996 Congressional Elections." *American Politics Research* 29(March): 141-82; Voss, D. Stephen, and Penny Miller. 2001. "Following a False Trail: The Hunt for White Backlash in Kentucky's 1996 Desegregation Vote." *State Politics and Policy Quarterly* 1(March):63-82; Lublin, David, and D. Stephen Voss. 2002. "Context and Francophone Support for Sovereignty: An Ecological Analysis." *Canadian Journal of Political Science* 35(March):75-101;

<sup>8</sup> Voss, D. Stephen and David Lublin. 1998. "Ecological Inference and the Comparative Method." APSA-CP: Newsletter of the APSA Organized Section in Comparative Politics 9(1):25-31; Voss, D. Stephen, and Penny Miller. 2017. "The Phantom Segregationists: Kentucky's 1996 Desegregation Amendment and the Limits of Direct Democracy." *Commonwealth Review of Political Science* 4(1): 21-38.

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[https://www.researchgate.net/publication/268341180\\_Racial\\_Polarization\\_and\\_Turnout\\_in\\_Louisiana\\_New\\_Insights\\_from\\_Aggregate\\_Data\\_Analysis](https://www.researchgate.net/publication/268341180_Racial_Polarization_and_Turnout_in_Louisiana_New_Insights_from_Aggregate_Data_Analysis)

<sup>10</sup> Computers cannot behave randomly, although they can imitate it. When analysts want a computer program to "randomly" generate numbers, but to do so in a way that can be repeated later or by someone else, they set a "seed" ahead of time. The same analysis, performed later with the same seed, will produce exactly the same results. Barreto's code attempted to set a seed, but failed to do so because of a typing error. Not knowing what seed his computer used, no one would be able to duplicate his results exactly in order to



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evaluate them.

<sup>11</sup> Strictly speaking, what I obtained were the block assignment files needed to construct these maps.

<sup>12</sup> SSD16 earned a Reock score of .38 and a Polsby-Popper score of .36, both better than the scores earned by more than half-a-dozen other districts statewide. The first indicates that SSD16 does not deviate excessively from a theoretical “perfect circle,” while the latter means that the district does not have a lot of jagged edges or tendrils relative to its overall size. Finally, the best compactness measure that DRA reports – the Know It When You See It (KIWYSI) score – puts SSD16 at a middling 50 out of 100, better than several other Florida Senate districts.

<sup>13</sup> I say “as if” because, in practice, neither the original mapmakers nor Dr. McCartan tried to contain the region’s five (5) districts within the counties defining the MSA. They linked the MSA’s outlying territory with adjacent counties outside the MSA. But that’s not necessarily sinister. Counties at the edges of an MSA sometimes have their largest population, and their densest population, close to and economically integrated with the central city, while the far-flung smaller communities elsewhere in the county may resemble the adjoining rural counties. Efforts to break apart an MSA need to be judged on a case-by-case basis.

<sup>14</sup> I say “obviously” because former Green Beret Jay Collins, a Republican, defeated the incumbent left over from the old maps, Sen. Janet Cruz, by a 54.4%-45.2% margin. But note that the new SSD14 that she lost was not significantly different in partisan competition from what her old SSD18 had become. The district was 49.76% Democratic and 48.15% Republican under the benchmark map, compared to 49.9% D and 47.98% R now. It was an exceptionally good year in Florida for Republicans.

<sup>15</sup> I make no judgment whether Ruskin or its specific geopolitical boundaries are more or less worthy of respect than other Florida places or Florida boundaries. I simply note that these changes do violence to both, despite the expectation that districting will respect these features of the map. Clearly other redistricting priorities have shaped the ACLU proposals.

<sup>16</sup> I say “these days” because at one time, such cracking of the Black vote was less about partisan goals – often the mapmakers and the African-American voters were both Democratic constituencies – and more uniquely racial in intent.

<sup>17</sup> Barreto claims in the text that he analyzed Pinellas County, but I have no evidence that claim is accurate. The code he provided sets up no such analysis (although applying it to Pinellas requires relatively trivial changes), and he furnishes no tables or figures from Pinellas to document the results. Finally, I note that in the part quoted here, he’s only referring to Hillsborough. So we were left guessing whether the reference to “Hillsborough and Pinellas County” is vestigial language, from a time when Barreto intended to perform a Pinellas County analysis that he didn’t actually get to complete, or if he actually did analyze Pinellas but excluded the results from his report.

<sup>18</sup> Technically speaking, King’s method assumes that the group’s voting behavior across small units follows a bell-shaped curve and can be expressed, in conjunction with the comparison social group’s voting behavior, as following a bivariate normal distribution.

<sup>19</sup> Counsel did not ask me to develop my own ecological inferences, only to assess and apply Barreto’s

approach. I am not, however, offering this criticism without a clear idea of what I would have attempted to improve the results. First, the Census Bureau collects and reports Hispanic nationality for the voting-age population at the tract level (although it's imperfect because they only report groups of 900 or larger). Second, the data Barreto used included information on the party registration of the Hispanic voters who cast ballots. Either of those data sources could have been incorporated into the ecological inferences performed here, to see whether they added stability to the estimation.

<sup>20</sup> He makes this claim in Appendix C on page 25, near the end of footnote 19: “we compared our results with models using VAP by race and ethnicity—for which a standalone non-Hispanic white race category exists in the data—and found substantively identical results.” I collapsed White and Other for VAP, so that the demographic categories would be the same for VAP and Turnout, and the results when estimating the vote in a Democratic primary are not what I would call substantively similar. The differences in what EI estimates for Hispanics are especially dramatic, which might not matter in some portions of Florida, but definitely can matter in Senate districts on the peninsula.

<sup>21</sup> We exclude the Hispanic results partly because they're so unstable, and partly just so the table would fit.

<sup>22</sup> Judging from their instructions, that appears to be how the data's creators envisioned their block-level estimates being used.