

# The Use of Ecological Regression to Estimate Racial Bloc Voting

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**I**SSUES INVOLVING the racial polarization of voting behavior have long been central to voting rights litigation in the United States.<sup>1</sup> Although the crux of the debate has changed over the years,<sup>2</sup> current

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1. There have been hundreds of vote dilution cases over the last decade. Most involve challenges to local at-large election schemes in which plaintiffs asserted that the at-large nature of the election coupled with bloc voting by whites against minority candidates led to the submergence of minority voting strength. See *THE QUIET REVOLUTION: MINORITY VOTING RIGHTS AND REPRESENTATION IN THE SOUTH* (Chandler Davidson & Bernard Grofman eds., forthcoming 1993) [hereinafter *QUIET REVOLUTION*] for a detailed discussion of voting rights cases prior to 1990 in eight Southern states.

2. Initially, racial bloc voting debates centered around that term's definition. Much of the expert witness testimony in voting rights cases offered between 1982 and 1986 could be seen as part of an ongoing struggle to affect the legal meaning of the term "racially polarized voting." From the mid-1970s onward, virtually no vote dilution case lacked an analysis of racial vote dilution by one or more social science expert witnesses. Bloc voting was too important a factor for plaintiffs not to put on evidence as to its presence, and proof of racially polarized voting made defeat too likely for defendant jurisdictions not to hire experts to rebut plaintiffs' experts' claims. Experts have usually been political scientists or sociologists, but also historians and, more recently, statisticians. The battle among these experts' terms brings to mind the oft-quoted passage from *Alice In Wonderland*: "'When I use a word,' Humpty Dumpty said in a rather scornful tone, 'it means just what I choose it to mean—neither more nor less . . . . The question is, which is to be master—that's all.'"

The Supreme Court gave a more or less definitive answer to this definitional question in *Gingles v. Edmisten*, 590 F. Supp. 345 (E.D.N.C. 1984), *aff'd in part & rev'd in part sub nom. Thornburg v. Gingles*, 478 U.S. 30 (1986) [hereinafter *Gingles*]. There, the Supreme Court identified a requisite level of racial bloc voting as one of the basic factors in the proof of a minority vote dilution challenge to an at-large or multi-member district system under the 1982 amendments to § 2 of the Voting Rights Act of 1965. 42 U.S.C. § 1973 (1988) [hereinafter *Act*].

After *Gingles*, the nature of the controversy shifted to issues such as the extent to which

debates center on the credibility of the evidence customarily used by plaintiffs to establish patterns of racially polarized voting.<sup>3</sup> Such evidence is often derived in large part from ecological regression on aggregate level precinct data and on analysis of election results in precincts that are absolutely or nearly racially homogeneous.

The debate in the federal courts as to the interpretation and measurement of racially polarized voting is important to public policy. The relative credence courts have placed in conflicting expert witness testimony about racial polarization often has determined whether plaintiffs or defendants prevailed in the jurisdictions where election practices have been challenged. This became especially true once racial bloc voting became the linchpin of any vote dilution case.<sup>4</sup>

This Article explains recent developments in aggregate modeling of electoral behavior, and focuses on the development of the double regression approach, which is intended to compensate for differential turnout or registration levels among black and white, Hispanic and non-Hispanic voters.<sup>5</sup> It also reviews methodological and legal errors in four recent

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elections involving only white candidates were relevant to a determination of racial bloc voting. Political scientists such as Harold Stanley, Ronald Weber, and John Wildgen have argued that black voters' success in electing white candidates of their choice precluded a successful voting rights challenge. This debate, too, has been resolved. The position taken by Stanley, Weber, and Wildgen has been rejected by most federal courts. District courts, such as that in which Wildgen testified for the City of Gretna, held that the ability of black voters to influence elections where only white candidates contested could not preclude a voting rights claim in situations where black voters were impaired in their ability to elect black candidates of choice because of the prevalence of white bloc voting. *Citizens for a Better Gretna v. City of Gretna*, 834 F.2d 496, 504 (5th Cir. 1987), *cert. denied*, 492 U.S. 905 (1989). In particular, Judge Collins, in the *Gretna* district court opinion, likened the argument that blacks could elect the white candidate of their choice to one made by Henry Ford in the days of the Model T when he asserted that: "Any customer can have a car painted any color he wants, as long as it is black." *Citizens for a Better Gretna v. City of Gretna*, 636 F. Supp. 1113, 1121 (E.D. La. 1986) (quoting JAMES P. BERRY, *HENRY FORD AND MASS PRODUCTION* 55 (1973)).

3. See James W. Loewen, *Racial Bloc Voting and Political Mobilization in South Carolina*, 19 REV. BLACK POL. ECON. 23 (1990), for a discussion of bloc voting results derived from analyses performed for litigation in numerous elections in South Carolina. This is especially true in the context of challenges to multi-member or at-large elections. For a discussion of legal issues involving the role of bloc voting analyses in cases involving challenges to single-member district plans, as opposed to multi-member or at-large plans, see, e.g., *Turner v. Arkansas*, 784 F. Supp. 553 (1991), *aff'd*, 112 S. Ct. 2296 (1992); cf. Bernard Grofman & Lisa Handley, *Identifying and Remedying Racial Gerrymandering*, 8 J.L. & POL. 345 (1992) [hereinafter *Gerrymandering*]; BERNARD GROFMAN ET AL., *MINORITY REPRESENTATION AND THE QUEST FOR VOTING EQUALITY* (1992) [hereinafter *MINORITY REPRESENTATION*].

4. The remarkable success rate of plaintiffs in § 2 litigation has affected outcomes in scores of other jurisdictions which have now shifted to single-member districts because of the fear of (or the actual threat of) a voting rights lawsuit. See QUIET REVOLUTION, *supra* note 1, at ch. 13.

5. See Bernard Grofman et al., *Effects of Multimember Districts on Black Representation*

attacks on ecological regression. This Article focuses particular attention on the claim by critics that estimates derived from the usual ecological regression approach have no credence. Some of this criticism is based on support for the neighborhood model approach which can derive estimates from any given aggregate level data set that result in very different implications for racial voting patterns.<sup>6</sup>

Part I of this Article describes the approach taken by the United States Supreme Court in defining racial bloc voting in the seminal case of *Thornburg v. Gingles*.<sup>7</sup> Part II discusses attacks that have since been leveled against the double regression approach, including the claim that bivariate ecological regression should be replaced with multivariate methods intended to account for why voters vote as they do as opposed to simply describing the extent to which blacks and whites, Hispanics and non-Hispanics vote differently;<sup>8</sup> the claim that double regression necessarily “ratchets” upward estimates of the degree of racial bloc voting and biases results;<sup>9</sup> and the claim that the results of ecological regression should be thrown out whenever there are violations, however minor, of certain statistical assumptions of linear regression.<sup>10</sup> Finally, Part III addresses the nihilistic claim that ecological inferences about racial voting patterns are inherently completely unreliable.<sup>11</sup>

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*in State Legislatures*, 14 REV. BLACK POL. ECON. 65 (1986) [hereinafter *Black Representation*]; James W. Loewen & Bernard Grofman, *Recent Developments in Methods Used in Vote Dilution Litigation*, 21 URB. LAW. 589 (1989) [hereinafter *Recent Developments*].

6. David A. Freedman et al., *Ecological Regression and Voting Rights*, 15 EVALUATION REV. 673 (1991). Many of the methodological issues raised in the debates among expert witnesses in voting rights cases concern what can reliably be inferred from aggregate data about different racial groups' electoral patterns. These issues are also of considerable general interest to social scientists concerned with developing contextual models of political behavior. That connection is taken up in Guillermo Owen & Bernard Grofman, *Recent Developments in Regression Techniques for Ecological Inference* (Jan. 1993) (unpublished manuscript, on file with School of Social Sciences, University of California, Irvine).

7. 478 U.S. 30 (1986). *Gingles*, a § 2 Act challenge to various legislative districts in North Carolina, has become the leading voting rights case with respect to the interpretation of the 1982 language added to § 2 of the Act. Since the amendment of § 2 virtually all vote dilution challenges, other than § 5 preclearance decisions, are brought under § 2.

8. Charles S. Bullock III, *Misinformation and Misperceptions: A Little Knowledge Can Be Dangerous*, 72 SOC. SCI. Q. 834 (1991).

9. John K. Wildgen, *Vote Dilution Litigation and Cold Fusion Technology*, 22 URB. LAW. 487, 488-89 (1990).

10. See Wildgen, *supra* note 9, at 488-89; see also Freedman et al., *supra* note 6.

11. Freedman et al., *supra* note 6.

## I. The Supreme Court's Approach to Defining Racial Bloc Voting in *Gingles*

Before the *Gingles* decision, there were three choices open to courts in approaching the question of how to define racial bloc voting. First, courts could focus on the magnitude of the correlation coefficient obtained when the support rate for minority candidates was regressed against the minority percentage in the voting precinct.<sup>12</sup> Second, courts could focus on the difference between the estimated support levels of minority candidates given by minority voters and the support those candidates were receiving from non-minority voters to see if the nature of the differences was non-trivial.<sup>13</sup> Lastly, courts could require that experts look at more than just the simple pattern of observed election results to try to determine whether racial animus was driving the choices of non-minority voters.

With regard to the third approach, defendants' expert witnesses proposed two different options. One option, suggested by political scientist Timothy O'Rourke, was to require evidence for indicators of racial backlash such as high levels of white/Anglo turnout in elections involving minority candidates or racial campaign appeals.<sup>14</sup> The second option involved using multivariate methods to determine whether race made an "independent" contribution to explaining patterns of voting once other factors such as newspaper endorsements, incumbency, campaign spending, voters' socioeconomic characteristics, etc., were controlled.<sup>15</sup>

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12. See *infra* note 18. A few experts in some early cases had done just that, treating, for example, correlation levels of .7 or so as *prima facie* evidence of polarization.

13. If courts took this tack, the obvious next question was what level of differences in support proved polarization. Many experts proposed to look at the sum of "own race" voting, i.e., the percentage of minority voters who voted for the minority candidate(s) added to the percentage of non-minority voters who voted for the non-minority candidate(s). Some experts for plaintiffs argued that an own race voting percentage that summed to above 160% was evidence of strong polarization. Others proposed lower figures, arguing for example that, in American politics, landslide proportions meant a 60-40 split, and thus a cutoff of 120% was appropriate. In contrast, some experts for defendants argued that unless the own race voting percentage exceeded 180% voting should not be considered polarized. A few experts had focused on the statistical significance of the differences in the homogeneous precincts, with "t" statistics and similar measures being offered in evidence. Bernard Grofman, *Expert Witness Testimony and the Evolution of Voting Rights Case Law*, in *CONTROVERSIES IN MINORITY VOTING* (Bernard Grofman & Chandler Davidson eds., 1992) [hereinafter *Expert Witness*].

14. Essentially this approach was accepted by a federal district court in *Collins v. City of Norfolk*, 605 F. Supp. 377, 388 (E.D. Va. 1984), based on testimony O'Rourke offered on behalf of the city.

15. A United States Court of Appeals judge argued for this approach in *Jones v. City of Lubbock*, 730 F.2d 233, 234-45 (5th Cir. 1986), and was followed by a federal district court in *McCord v. City of Fort Lauderdale*, 617 F. Supp. 1093 (S.D. Fla. 1985), *aff'd*, 787 F.2d 1528 (11th Cir.), *vacated en banc*, 804 F.2d 611 (1986).

In *Gingles* the Court created a unique synthesis of the three options. The Court's approach opted in favor of the "common sense" notion of racially polarized voting as reflecting differences in the voting behavior of groups that had characterized virtually all of the earlier vote dilution cases where bloc issues were raised.<sup>16</sup> The court relied upon the expert witness testimony at trial<sup>17</sup> and the analytical framework for understanding vote dilution published by civil rights attorneys James Blacksher and Larry Menefee.<sup>18</sup>

In *Gingles* the Supreme Court laid down the definition of racially polarized voting that was henceforth to govern vote dilution cases. The definition was one I offered as an expert witness for plaintiffs that was also adopted by the lower court. Under this definition, voting is considered polarized when there is " 'a consistent relationship between the race of the voter and the way in which the voter votes,' or to put it differently, where 'black voters and white voters vote differently.' "<sup>19</sup>

The Supreme Court's inquiry into racial polarization in *Gingles* went further than a finding that such polarization existed there. The Court emphasized the distinction between the existence of racial polarization per se and the question of whether that polarization is of practical or legal significance. In particular, the Court recognized that racially polarized voting was neither a necessary nor a sufficient condition for minority electoral loss. The standard set by the Court to determine when racially polarized voting is legally significant was as follows: it must first be shown that "the white majority votes sufficiently as a bloc to enable

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16. See *infra* note 19 and accompanying text. See also *Beer v. United States*, 425 U.S. 130 (1976); *Expert Witness*, *supra* note 13.

17. I was the expert witness for the minority plaintiffs in *Gingles v. Edmisten*, 590 F. Supp. 345 (E.D.N.C. 1984), *aff'd in part & rev'd in part sub nom. Thornburg v. Gingles*, 478 U.S. 30 (1986), on matters relating to racial bloc voting and minority electoral success. The trial court relied mostly on my testimony. Justice Brennan's opinion, while extensively citing my trial testimony, 478 U.S. at 53-54, also cited a number of articles on racial bloc voting and related issues by other political scientists such as Richard Engstrom and Michael McDonald. *Id.* at 53 n.20.

18. James U. Blacksher and Larry T. Menefee, *From Reynolds v. Sims to City of Mobile v. Bolden: Have the White Suburbs Commandeered the Fifteenth Amendment?*, 34 *HASTINGS L.J.* 1 (1982).

19. *Gingles*, 478 U.S. at 53 n.21. That definition, in turn, had been adapted from the approach taken by expert witnesses such as Robert Brischetto, Charles Cotrell, Chandler Davidson, Richard Engstrom, Alan Lichtman, and James Loewen in numerous previous voting rights cases.

In footnote 21, the Supreme Court also asserts that "racial polarization" can be established in terms of observed "correlations" between the racial composition of election districts and candidate choices in those units, at least insofar as a correlation between race of the voter and the way in which the voter votes implies differences in the voting behavior of minority and non-minority voters. *Id.*

it—in the absence of special circumstances . . . —usually to defeat the minority's preferred candidate."<sup>20</sup> Second, it must be shown that the minority group is "politically cohesive."<sup>21</sup>

According to this Court, "[a] showing that a significant number of minority group members usually vote for the same candidates is one way of proving the political cohesiveness necessary to a vote dilution claim."<sup>22</sup> These two inquiries, whether minority group members constitute a politically cohesive unit and whether whites vote sufficiently as a bloc usually to defeat the minority's preferred candidate, comprise two elements of what has come to be called the *Gingles* three-pronged test.<sup>23</sup> The third element requires the minority group be shown to be "sufficiently large and geographically compact to constitute a majority in a single-member district."<sup>24</sup>

Even after *Gingles* was decided, some social scientists continued to offer testimony about racial bloc voting that was incompatible with the Court's holding.<sup>25</sup> Once the Supreme Court had identified a clear definition of racial polarization, however, social scientists offering definitions that were incompatible would normally not be listened to by lower courts. For example, in *McNeil v. City of Springfield*,<sup>26</sup> Charles Bullock, a political scientist who testified as an expert witness for the city, as-

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20. *Id.* at 51.

21. *Id.*

22. *Id.* at 56. In *Gingles*, the inquiry into polarization was thus effectively bifurcated. The first inquiry considers whether or not polarization exists. The second question is whether or not it is legally significant. This second inquiry is itself bifurcated. It requires two "discrete inquiries," the first into "minority" voting practices, and the second into "white voting practices." *Id.* In expert witness testimony at trial the "two halves" of racial bloc voting are often presented together.

The Supreme Court's eventual definition was identical to the one I offered at trial in two of its three elements, and similar in the third. In my testimony in *Gingles*, I proposed that we define substantively significant racially polarized voting as that which occurs when the candidate chosen by voters of one race differs from the candidate chosen by voters of the other race. The Supreme Court took a different tack and used legally significant racial bloc voting as one of its three prongs. The Court defined that phrase in terms of the level of success achieved by minority candidates in situations where there was white bloc voting and minority political cohesion. With the advantage of hindsight, I prefer Justice Brennan's approach, which derives in large part from Blacksher, *supra* note 18, to the one I proposed.

23. *Gingles*, 478 U.S. at 50-51.

24. *Id.* Racial bloc voting had been a key factor in vote dilution cases even prior to *Gingles*. See MINORITY REPRESENTATION, *supra* note 3, for discussion of cases prior to *Gingles*.

25. My testimony in *Gingles* in most respects merely codified and clarified the views about the definition and measurement of racial bloc voting that had been put forward by plaintiffs' experts in previous cases and accepted by federal courts, including the Supreme Court in such early cases as *Beer v. United States*, 425 U.S. 130 (1976).

26. 658 F. Supp. 1015 (C.D. Ill. 1987).

serted that one needed 180% "own-race" voting before it was appropriate to refer to voting as polarized. Bullock, however, was forced to testify that few of the elections found to be polarized by the Supreme Court in *Gingles* would meet his test.<sup>27</sup> His classification was then rejected by the trial court as lacking credibility.<sup>28</sup> Similarly, in *Jackson v. Edgefield County South Carolina School Board*,<sup>29</sup> the testimony of Harold Stanley, a political scientist testifying for the county, was rejected:

for the reasons supplied by the [*Gingles*] court. The Stanley definition, as applied to a statutory claim for a Section 2 [violation] is flawed because it relies on the interjection of a consideration of racial motive as a primary determinative cause for the racially divisive voting behavior. Under the definition of racially polarized voting as approved by the *Gingles* Court, proof of white voters' racial hostility toward black candidates that is actually the cause of the voter behavior is no longer a relevant inquiry.<sup>30</sup>

Several years later, although his testimony about racial bloc voting no longer focused exclusively on its causes, Professor Stanley's findings about bloc voting were again held to be incompatible with *Gingles* and were again disregarded. In *Bradford County NAACP v. City of Starke*,<sup>31</sup> Stanley's claim that "racially polarized voting does not exist in Starke because blacks and whites generally support the same winning candidate (66 of the 98 elections, or 71%)"<sup>32</sup> was rejected for a number of reasons. Those reasons included a failure to consider all the relevant elections in such a fashion that the sample significantly skewed away from elections in which polarization was most likely. It was also rejected because, contrary to *Gingles*: "In conducting his analysis, Dr. Stanley neither limited the data he considered to elections involving black candidates nor did he place any additional weight on those elections involving black candidates or white candidates who had exhibited any special or unique affinity for the interests of black citizens."<sup>33</sup>

## II. Attacks on the Reliability of Ecological Regression

In terms of measuring racial bloc voting, the *Gingles* opinion provided considerable legitimacy to the use of homogeneous precinct analysis and ecological regression. The Court found the techniques appropriate to estimate the levels of white and black support for particu-

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27. *Id.* at 1029.

28. *Id.*

29. 650 F. Supp. 1176 (D.S.C. 1986).

30. *Id.* at 1197 (citations omitted).

31. 712 F. Supp. 1523 (M.D. Fla. 1989).

32. *Id.* at 1533.

33. *Id.*

lar candidates in the absence of reliable election survey data to be analyzed.<sup>34</sup> In *Gingles*,<sup>35</sup> Justice Brennan repeated the lower court's characterization of these as "standard" techniques for the analysis of racially polarized voting and provided references to published articles by social scientists that characterize them in this fashion.<sup>36</sup> In part as a consequence of this language in *Gingles*, and also because these techniques had already in fact been seen as standard, their use in subsequent cases became routine.<sup>37</sup> Experts for both plaintiffs and defendants now present nearly identical ecological regression or homogeneous precinct estimates,<sup>38</sup> even if they do not agree on the legal significance of the parameters they report.<sup>39</sup> Nonetheless, a few experts (invariably ones employed by attorneys for defendant jurisdictions) have found ways to

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34. In voting rights cases the best evidence on racial polarization is evidence from the type of elections that are under challenge. Most elections for which racial voting patterns must be estimated are local elections where survey data is unavailable. Because data on electoral patterns over more than one election year is desirable, requiring plaintiffs to do exit polls or other types of surveys effectively prohibits timely lawsuits. Exit polls are costly and requiring them might be seen as imposing unfair barriers on the limited resources of minority plaintiffs. Also, sample size problems decrease poll result reliability when data is broken out according to racial or linguistic subgroups. In intensely contested and highly polarized elections, voters may lie to interviewers about whether or not they have voted for candidates of another race, or voters with intense racial views may be less likely to fill out a survey instrument. For example, the phenomenon of over-reporting white support for black candidates was manifest in pre-election polls in the Wilder contest in Virginia and the David Dinkins contest in New York City. See Richard Engstrom and Michael McDonald, *Enhancing Factors in At-Large Plurality and Majority Systems: A Reconsideration*, 17 ELECTORAL STUD. (forthcoming 1993).

35. 478 U.S. 30.

36. *Id.* at 53 n.20.

37. In judging the statistical significance of the correlation coefficients obtained in ecological regressions of support levels for minority candidates versus the percent minority in the voting precinct, the Court accepted the accuracy of the conclusion that had been offered in my expert witness testimony in *Gingles* that the data "reflected positive relationships and that the correlations did not happen by chance." *Gingles*, 478 U.S. at 53 n.22. Thus, the specific thresholds for statistical significance that I offered in *Gingles* and that were accepted by the Court, in effect, became incorporated into the voting rights case law.

38. In *Gingles*, Theodore Arrington for the Republican plaintiff intervenors, Thomas Hoffeller for the defendants, and myself for the minority plaintiffs presented similar estimates of black-white differences in voting support for black candidates. In like manner, the estimates of black-white voting differences by Charles Bullock for the defendant jurisdiction and Race Davies for plaintiffs in *McNeil v. City of Springfield*, 658 F. Supp. 1015 (C.D. Ill. 1987), were virtually identical, as were the estimates of Ronald Weber for the defendant jurisdiction and Richard Engstrom for plaintiffs in *Chisom v. Roemer*, 111 S. Ct. 2354 (1991).

39. I have previously noted how Professor Bullock, in his testimony in *McNeil*, offered a threshold test to determine when voting was "truly" polarized along racial lines. The testimony was rejected by the trial court as incompatible with the teachings of *Gingles*. Similarly, in *Chisom*, Professor Weber reached different conclusions than Professor Engstrom concerning whether voting was racially polarized in New Orleans and Jefferson Parish. The conclusion was different because Professor Weber, unlike Professor Engstrom, placed great weight on results in contests in which there were no black candidates running.



challenge the findings about racial polarization based on ecological regression and homogeneous precinct analyses.

The most persistent attacks on the reliability of ecological regression techniques in voting rights cases have come from political scientist John Wildgen in his testimony for defendant jurisdictions in cases such as *Citizens for a Better Gretna v. City of Gretna*,<sup>40</sup> a challenge to a local at-large election system, and *Jeffers v. Clinton*,<sup>41</sup> a case that challenged single-member-district plans for both branches of the Arkansas legislature. Attacks have also come from statisticians David Freedman and Jerome Sacks, educational psychologist Stephen P. Klein, and demographer Peter A. Morrison, who are part of a group of experts frequently employed by John McDermott, a California attorney who has defended several voting rights lawsuits against local California jurisdictions.<sup>42</sup> Since the late 1980s these and other expert witnesses for defendant jurisdictions have written articles for social science journals and law reviews repeating, often nearly verbatim, the trial arguments they made that were rejected by the court.<sup>43</sup>

For example, David Freedman, Stephen P. Klein, Jerome Sack, C. Smyth, and Charles Everett in a 1991 article<sup>44</sup> repeat nearly verbatim the testimony offered by the first three co-authors that was rejected by the

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40. 834 F.2d 496, 502 (5th Cir. 1987), *cert. denied*, 492 U.S. 905 (1989).

41. 730 F. Supp. 196, 208 (E.D. Ark. 1989), *aff'd*, 498 U.S. 1019 (1991).

42. One or more of this latter set of experts were hired by defendant jurisdictions in *Romero v. City of Pomona*, 883 F.2d 1418 (9th Cir. 1989); *Gomez v. City of Watsonville*, 863 F.2d 1407 (9th Cir. 1988), *cert. denied*, 489 U.S. 1080 (1989); *Badillo v. City of Stockton*, No. S-87-1726 E.J.G. (E.D. Cal. 1989); *Skorepa v. City of Chula Vista*, 723 F. Supp. 1384 (S.D. Cal. 1989).

43. In the 1980s a number of social scientists whose bloc voting testimony had been accepted by trial courts wrote articles explaining the nature of their methodology. Several of these articles were cited in *Gingles*, and a few were cited extensively, e.g., Richard L. Engstrom & Michael D. McDonald, *Quantitative Evidence in Vote Dilution Litigation: Political Participation and Polarized Voting*, 17 URB. LAW. 369 (1985); Bernard Grofman et al., *The "Totality of Circumstances Test" in Section 2 of the 1982 Extension of the Voting Rights Act: A Social Science Perspective*, 7 LAW & POL'Y 199 (1985) [hereinafter *Totality of Circumstances*]. Indeed, one of the more remarkable features of the *Gingles* opinion is its 17 citations to articles by social scientists. Moreover, unlike the frequent lawyerly practice of only drawing on social science materials that had been given the imprimatur of acceptance by a law review, many of the Court's citations to social science materials were to articles in social science journals. These materials were used in the opinions to support or to critique the expert witness testimony that was being reviewed. While a good number of these citations were no doubt "window-dressing," I do believe that some of these articles proved influential in informing the Court about the methodological issues involved in defining and measuring racial bloc voting. In like manner, experts whose views have been rejected by courts have sought both professional vindication and the potential to influence appellate courts by writing articles that might be read by judges as well as by fellow academic professionals.

44. Freedman et al., *supra* note 6.

district court in *Garza v. Los Angeles County Board of Supervisors*.<sup>45</sup> Similarly, Wildgen in a recent article<sup>46</sup> repeats arguments rejected by the *Gretna*<sup>47</sup> and *Jeffers*<sup>48</sup> courts.

### A. Racial Bloc Voting Analysis: Description versus Explanation

In *Gingles*, Justice Brennan's plurality opinion decisively rejected a claim made by the defendant jurisdiction and supported by the United States as amicus curiae that, as a matter of law,<sup>49</sup> race must be shown to be the "primary determinant of voting behavior" for voting to be found to be racially polarized.<sup>50</sup> Justice Brennan specifically rejected approaches to racially polarized voting that had been accepted by lower courts in earlier cases involving the cities of Norfolk, Virginia, and Fort Lauderdale, Florida.<sup>51</sup> Justice Brennan asserted that "the legal concept of racially polarized voting incorporates neither causation nor intent. It means simply that the race of voters correlates with the selection of a certain candidate or candidates; that is, it refers to the situation where different races (or minority language groups) vote in blocs for different candidates."<sup>52</sup>

Even if multivariate analyses seeking to specify the factors that explain voting patterns, with race only one such factor, had not been ruled out by *Gingles* as legally irrelevant,<sup>53</sup> there are severe social scientific difficulties in seeking to explain racial differences in voting. Social science testimony, seemingly rooted in powerful statistical tools, can mislead attorneys and judges not trained to find the substantive errors in the empirical applications of statistical methodology. These difficulties can be illustrated with respect to Charles Bullock's testimony in *McCord*.<sup>54</sup>

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45. 756 F. Supp. 1298 (C.D. Cal.), *aff'd*, 918 F.2d 763 (9th Cir. 1990), *cert. denied*, 111 S. Ct. 681 (1991).

46. Wildgen, *supra* note 9.

47. *Gretna*, 834 F.2d 496, 502 (5th Cir. 1987), *cert. denied*, 492 U.S. 905 (1989).

48. *Jeffers*, 730 F. Supp. 196 (E.D. Ark. 1989), *aff'd*, 498 U.S. 1019 (1991).

49. As a matter of appropriate statutory interpretation of the 1982 language of the amended § 2 of the Act.

50. *Gingles*, 478 U.S. at 30, 62 (1986).

51. See *Collins v. City of Norfolk*, 605 F. Supp. 377 (E.D. Va. 1984); *McCord v. City of Fort Lauderdale*, 617 F. Supp. 1093 (S.D. Fla. 1985), *aff'd*, 787 F.2d 1528 (11th Cir.), *vacated and reh'g granted*, 804 F.2d 611 (11th Cir. 1986).

52. *Gingles*, 478 U.S. at 62.

53. The factors are irrelevant given the purely descriptive definition of racial bloc voting that is the Supreme Court's interpretation of the congressional language in the 1982 amendments to the Act. The definition given in *Gingles* is clearly rooted in the language of and previous case law about the Act. See MINORITY REPRESENTATION, *supra* note 3, at ch. 3.

54. *McCord v. City of Fort Lauderdale*, 787 F.2d 1528, 1532 (11th Cir.), *vacated*, 804 F.2d 611 (11th Cir. 1986). Bullock was an expert for the City of Fort Lauderdale. Bullock's

Professor Bullock testified in *McCord* that, because the variable “race of candidate” was not significant in explaining variance in the dependent variable (raw candidate votes) beyond what could be accounted for by other variables, race was not a real factor in accounting for voting patterns in Fort Lauderdale. Both the district and the appellate courts in *McCord* accepted this interpretation of the multivariate regression result as implying that voting in the city was not racially polarized. The appellate court stated:

When race was added to other independent variables applied to voting statistics for past city commission races, the race factor explained only 0.6 of one percent of the dependent variables [sic] of candidate success, thus leading defendant’s expert and the district court to conclude that race was not a statistically significant variable.<sup>55</sup>

This interpretation is simply wrong.

The multivariate methodology used in *McCord* is misguided for four reasons.<sup>56</sup> First, if there are many more white candidates than black candidates, race of candidate cannot possibly explain most of the variance in election success since most of the contests are white versus white. Including the votes for white candidates in white-white contests among the data to be explained necessarily reduces the possible explanatory power of the “race of candidate” variable. In Fort Lauderdale elections, for example, there were seven black candidates and seventy-five white candidates running for the city commission between 1970 and 1979.<sup>57</sup>

Second, the methodology used in *McCord* is virtually certain to show that there is no racially polarized voting, regardless of the actual level of racially polarized voting in a jurisdiction. There are so many other variables collinear with race used that they almost certainly will reduce significance of race in a multivariate regression. Race, when entered as the last variable in a multivariate regression equation that con-

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methodology in *McCord* became the model for a number of subsequent attempts to rebut a showing of racially polarized voting.

55. *Id.* at 1532.

56. Similar flaws are found in expert witness testimony by experts for defendant jurisdictions in *Gretna*, 834 F.2d 496 (5th Cir. 1987), and in *Romero*, 833 F.2d 1418 (9th Cir. 1989), where experts largely copied Bullock’s *McCord* methodology.

57. The analysis offered by Bullock in *McCord* was related to his own previously published 1984 work on racial voting patterns. See CHARLES S. BULLOCK III, IMPLEMENTATION OF CIVIL RIGHTS POLICY (1984). In the 1984 work, racial crossover is the independent variable, but in *McCord*, votes received by each black or white candidate was used as the independent variable instead of votes received by the set of white or black candidates as a whole. In the 1984 work, black candidates are looked at as a class; in *McCord*, each candidate’s vote total is looked at separately. In the 1984 work, only those election contests in which there was at least one black candidate are used, but in *McCord*, all election contests are included, even though the overwhelming majority of them were white-versus-white contests.

tains incumbency, campaign spending, newspaper endorsements, candidate gender, and levels of voter turnout by race as the earlier explanatory independent variables, adds no further explanatory power. In fact, it offers nothing of significance about racial polarization in black-white contests in Fort Lauderdale, or elsewhere. Many of the variables that are used as independent variables in this multivariate regression are surrogates for race (or at least highly correlated with it).<sup>58</sup> Similarly, if most incumbents are white, then a finding that incumbents do better than non-incumbents, regardless of race of non-incumbents, does not imply that race of candidate is irrelevant to outcome. When blacks become incumbents they may do well, but racially polarized voting may make it considerably less likely that black candidates will attain this status than will whites.

Third, factors that account for the dispersion of votes among individual white candidates and/or the dispersion of votes among individual black candidates can be entirely irrelevant to the question of how well black candidates fare as a class.

Fourth, if the election does not involve a head-to-head contest, but rather a vote-for-several situation,<sup>59</sup> then the problems identified above are even further exacerbated. In particular, minorities may succeed in multi-candidate contests to the extent that white voters split their votes among a number of white candidates.<sup>60</sup> Dispersion of white votes among white candidates does not change the level of bloc voting, but can change which candidates are elected.<sup>61</sup>

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58. As the dissent in *McCord* points out, the additional factors that are commonly entered in a multivariate analysis of candidate success such as "campaign expenditure, identification, income, media advertisement, religion, name recognition, position on key issues—are also closely correlated to race. It is a fair bet that blacks spend less on their campaigns and on media advertising because the overwhelming majority of their contributors are black and poor." 787 F.2d at 1535 (Swygert, J., dissenting); see also Richard L. Engstrom, *The Reincarnation of the Intent Standard: Federal Judges and At-Large Election Cases*, 28 *How. L.J.* 495, 495-573 (1985).

59. This was true in Fort Lauderdale's multi-member districts where each voter was able to cast up to five votes and there were no numbered places.

60. The fact that number of candidates may be related to minority candidate success tells us nothing about the magnitude of racially polarized voting. The number of candidates and minority success could well be highly correlated even if voting were completely polarized along racial lines because only when a large number of white candidates run are blacks able to be elected.

61. In my 1991 article from which the above discussion is drawn I also provide a hypothetical data set to illustrate these four points. Bernard Grofman, *Multivariate Methods and the Analysis of Racially Polarized Voting: Pitfalls in the Use of Social Science by the Courts*, 72 *Soc. Sci. Q.* 826-33 (1991) [hereinafter *Multivariate Methods*]; see also Bernard Grofman,

## B. Is Double Regression Biased Upwards in its Estimates of Bloc Voting?

In his recent courtroom testimony,<sup>62</sup> a forthcoming 1993 article,<sup>63</sup> and an earlier work,<sup>64</sup> John Wildgen has taken particular aim at a technique for drawing inferences about racial patterns of voting known as "double regression."<sup>65</sup> Wildgen has claimed that the double regression technique biases estimates of racial bloc voting upward and thus is inherently favorable to the positions about the presence of racial bloc voting customarily advanced by plaintiffs.<sup>66</sup> Wildgen is not shy in characterizing the double regression method as a statistical hobgoblin, one which he

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*Statistics Without Substance: A Critique of Freedman et al. and Clark Morrison*, 15 EVALUATION REV. 746 (1991) [hereinafter *Statistics*].

In being asked about his *McCord* multivariate analysis in a subsequent voting rights lawsuit in which he testified for the defendant jurisdiction (in Springfield, Illinois), it appeared that Professor Bullock had abandoned the *McCord* type analysis as methodologically unsound. See *McNeil v. City of Springfield*, 658 F. Supp. 1015 (C.D. Ill. 1987), *cert. denied*, 490 U.S. 1031 (1989). But in *Bullock*, *supra* note 8, Professor Bullock offered a new defense of his original analysis against the arguments listed above. The version of my arguments to which Bullock is responding is that found in *Multivariate Methods*, *supra*. For my further response to Professor Bullock's arguments, see Bernard Grofman, *Straw Men and Stray Bullets: A Reply to Bullock*, 72 SOC. SCI. Q. 840 (1991) [hereinafter *Straw Man*].

62. For example, in Wildgen's written report as an expert witness for the State of Arkansas in *Jeffers v. Clinton*, 730 F. Supp. 796 (E.D. Ark. 1989), an Act challenge to legislative redistricting in Arkansas, Wildgen writes about double regression, stating that it "is not regression, it is not statistics, it is not science. Even though the Supreme Court sanctions flexibility in Section 2 inquiries, it strains credulity that they will countenance ad-hoc mathematical mutants, 'statistoids,' like double regression once they are made aware of their scientific baselessness." John K. Wildgen, *Alchemy in Arkansas: Polarization and Propaganda in the Ecological Analysis of Elections* (1989) (unpublished report prepared in connection with *Jeffers v. Clinton*, 730 F. Supp. 796 (E.D. Ark. 1989)). This view of double regression was not found credible by the *Jeffers* court, which instead accepted the testimony of Richard Engstrom, an expert witness for the plaintiffs, about the racial structure to voting patterns in Arkansas elections involving black versus white contests.

63. John K. Wildgen, *Social Alchemy in the Courtroom: The Double Regression Hoax*, 71 SOC. SCI. Q. (forthcoming 1993) [hereinafter *Social Alchemy*].

64. Wildgen, *supra* note 9.

65. The technique is known as "double" regression because it combines information from two separate regression equations. For a discussion of double regression methodology sources, see *infra* note 69.

66. Wildgen makes three other claims about double ecological regression methodology: (1) he asserts that this regression-based technique should not be called "regression" because it violates the formal assumptions of linear regression; (2) he asserts that double regression should not be called "bivariate," even though each equation used in it has only one independent and one dependent variable; and (3) he rejects the claim that this methodology "cures the ecological fallacy." *Social Alchemy*, *supra* note 63. The second assertion is a trivial definitional quibble lacking in substantive implications. The first and third complaints are directed against a straw man largely of Wildgen's own imagination. All three issues are discussed in Bernard Grofman, *Rejoinder: Throwing Darts at Double Regression and Missing the Target: A Reply to Wildgen*, 74 SOC. SCI. Q. (forthcoming 1993) [hereinafter *Rejoinder*]. I discuss the

appears to believe was diabolically conjured up by myself<sup>67</sup> in order to mislead federal courts by producing inaccurate overestimates of racial polarization which are allegedly incapable of disproof.<sup>68</sup>

Double regression is a straightforward and sensible solution to a problem peculiar to aggregate level electoral research.<sup>69</sup> The problem is the need to provide a statistical corrective for divergence between a group's share of the eligible electorate and its share of the actual electorate in situations where only the former is known with surety.<sup>70</sup> In gen-

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first and third issues below. See also Allan Lichtman, *Passing the Test: Ecological Regression Analysis in the Los Angeles County Case and Beyond*, 125 EVALUATION REV. 770 (1991).

My general views are that Wildgen's wild-eyed attacks on double regression not only never hit the bullseye, they mostly miss the dartboard entirely. On the rare occasions where Wildgen's criticisms are legitimate, as where he criticizes judicial misunderstandings of the correlation coefficient, what he has to say has been said by others, myself included.

67. As noted earlier, while I would like to take credit for being the sole discoverer of the double equation technique, it has been independently discovered/rediscovered by a number of social scientists. See *infra* note 69.

68. To simplify the discussion below I will refer to the minority group as "black." I will also only discuss elections in which there is at least one black and at least one white candidate. These are the elections which courts have held to be most probative of polarization. See MINORITY REPRESENTATION, *supra* note 3; *Gerrymandering*, *supra* note 3.

69. The double regression technique has become standard in voting rights litigation since 1986 as an improvement on the previous single equation method. See *Recent Developments*, *supra* note 5; Bernard Grofman, *Models of Voting*, in MICROPOLITICS ANNUAL 31-61 (Samuel Long ed., 1992). Double regression is a technique that was independently arrived at by a number of scholars from several different social science disciplines, including history. See PAUL KLEPPNER, CHICAGO DIVIDED: THE MAKING OF A BLACK MAYOR (1985); MORGAN KOUSSER, THE SHAPING OF SOUTHERN POLITICS: SUFFRAGE RESTRICTION AND THE ESTABLISHMENT OF THE ONE-PARTY SOUTH, 1880-1910 app. (1974); MORGAN KOUSSER, SOCIAL SCIENCE HISTORY (1974); JAMES LOEWEN, SOCIAL SCIENCE IN THE COURTROOM (1982); Allan Lichtman, *Passing the Test: Ecological Regression Analysis in the Los Angeles Case and Beyond*, 15 EVALUATION REV. 777 (1991). Indeed, double regression may have been used by E. Terence Jones to generate data for a voting rights case as early as 1971. James Loewen, personal communication, October 29, 1992. As far as I am aware, however, the double equation methodology was not specifically referred to by any court until findings based on my own 1982 uses of the technique were commented upon at length in *Gingles* and then by the Supreme Court. See *Totality of Circumstances*, *supra* note 43.

70. Wildgen asserts that the virtual absence of double regression outside of the voting rights context shows that it lacks validity. See *Social Alchemy*, *supra* note 63. Rather, its use has been largely confined to the courtroom because: (1) its most straightforward application is the context of the special type of problem that arises in the voting rights context of needing to estimate votes by race when information about the size of the minority electorate is lacking and information about the size of the pool of eligibles must be appropriately substituted; (2) because the elections that are of most relevance in voting rights cases are usually local elections for which survey data are not available, while the elections of most interest to political scientists are national (or statewide) elections for which reliable survey data is available; and (3) because, quite simply, the double regression technique is not yet as well known outside the voting rights litigation context so that those who might have used the method (e.g., political scientists and historians interested in historical voting patterns) have not been aware of its existence. For potential survey data limitations, see James W. Loewen et al., *It Ain't Broke, So*

eral it is important to know what proportion of the black and the white electorate supported the black candidate or candidates.<sup>71</sup> Absent reliable survey data broken down by race, the only information that directly bears on this question is derived from analysis of the relationship between percent black among the electorate and the vote share from among that same electorate received by the black candidate. One problem is that, in most voting rights cases, the black percent of the actual electorate is not known. Only their percentage in the eligible electorate is known.<sup>72</sup>

To take an extreme situation, suppose that all of the eligible whites vote but only 50% of the eligible blacks do so. In this situation, the relationship between the black share of the electorate and the black share of the eligible voters will be nonlinear. Let  $x$  be the fraction of blacks among eligible voters in a given precinct. In any given precinct,

$$\begin{aligned}\text{Black share of turnout} &= (.5(1-x)) / (.5(1-x) + x) \\ &= (.5 - .5x) / (.5 + .5x)\end{aligned}$$

For example, if the black share of eligibles ( $1 - x$ ) is .500, then the black share of the turnout is only .333. However, if the black share of eligibles is .100 then the black share of the turnout is only .052. If the black share of eligibles is .900 then the black share of the turnout is .818. The above formula<sup>73</sup> readily generalizes. If it is the case that  $k$  fraction of the eligible whites vote and  $j$  fraction of the eligible blacks vote, then

$$\begin{aligned}\text{Black share of turnout} &= (j(1-x)) / (j(1-x) + kx) \\ &= (j - jx) / (j + (k - j)x)\end{aligned}$$

Again we have a nonlinear function in  $x$ . Because of this nonlinearity, any regression that uses the black share of eligibles as a proxy for the black share of turnout is potentially suspect. The problem becomes serious, however, only as the difference between the turnout levels of white and black eligibles grows.<sup>74</sup>

For example, consider a hypothetical case where 90% of blacks vote for the black candidate and 90% of whites vote for the white candidate,

*Don't Fix It: The Legal and Factual Importance of Recent Attacks on Methods Used in Vote Dilution Litigation*, 27 U.S.F. L. REV. (forthcoming 1993).

71. For simplicity, I will henceforth assume a single black candidate. Multiple minority candidate situations are described in Bernard Grofman & Michael Migalski, *Estimating the Extent of Racially Polarized Voting in Multicandidate Elections*, 16 SOC. METH. & RES. 427 (1988) [hereinafter *Polarized Voting*].

72. Voting age population ("VAP") data is available from the census at the block level and can usually be matched to precincts. In a handful of states, registration by race is available at the precinct level.

73. This is a nonlinear function of  $x$ , a repeating fraction which may be approximated by a polynomial function of order  $n$ .

74. See *Recent Developments*, *supra* note 5.

and 50% of black eligibles vote while white turnout is 100% of eligibles. For these assumptions, it can be shown by regressing the black candidate's share of the vote on the black share of the eligibles, the estimated black vote for the black candidate is roughly 80% (too low) and white vote for the black candidate is 3% (also too low).<sup>75</sup> However, these estimates are still not that far from the actual values. With the double equation method, unlike the single equation method, we obtain the proportions of each race voting for the black candidate exactly right.

The statistical trick used by double regression to cope with the non-linearity from differential turnout by race is based on the fact that it is possible to do two straightforward linear regressions in which the black share of voters is the appropriate independent variable. This is done by regressing the independent variable on a variable which has the same denominator.

The first of the double regressions<sup>76</sup> is one in which the variable defined as "number of votes for the black candidate/number of *eligible* voters" is regressed on the variable "proportion black among eligibles." The second<sup>77</sup> is one in which the variable defined as "number of votes for the white candidate/number of *eligible* voters" is regressed on the variable "proportion black among eligibles."

The dependent and independent variables in these regressions have consistent denominators. In contrast, if we had used as our dependent variable "number of votes for the black candidate/number of *actual* voters" or "number of votes for the white candidate/ number of *actual* voters," then we would have had inconsistent denominators.

The two regressions specified above allow us to estimate the quantities:

$P_{WW}$  = the proportion of white *eligibles* who vote for the white candidate(s);

$P_{BW}$  = the proportion of black *eligibles* who vote for the white candidate(s);

$P_{BB}$  = the proportion of black *eligibles* who vote for the black candidate(s);

$P_{WB}$  = the proportion of white *eligibles* who vote for the black candidate(s).

We can use these four variables (which we may think of as intermediates) to estimate the significant proportions. For example, the proportion of the white *voters* who vote for the white candidate is estimated simply as  $P_{WW}/(P_{WW} + P_{WB})$ .

75. See *Rejoinder, supra* note 66.

76. See Appendix.

77. See Appendix.



The double equation method fully compensates for the turnout differential by race that we built into our hypothetical data base. If we apply the double equation method to the hypothetical described directly above, then we obtain the equations

$$y_1 = .35x + .1$$

and

$$y_2 = -.85x + .9$$

Thus,<sup>78</sup>

$$P_{WW} = .9; P_{WB} = .1; P_{BB} = .45; \text{ and } P_{BW} = .05.$$

The proportion of the white voters who vote for the white candidate, which is estimated simply as  $P_{WW}/(P_{WW} + P_{WB})$ , is estimated by the double equation method as .9 (the actual value). The proportion of the black voters who vote for the white candidate, which is estimated simply as  $P_{BW}/(P_{BW} + P_{BB})$ , is estimated by the double equation method as .1 (the actual value).

Note that in this hypothetical, where turnout differences between black and white eligibles are severe and black turnout is lower than white turnout, the single equation method causes us to underestimate the black vote for the black candidate by ten percentage points.<sup>79</sup> But here higher estimates are more accurate estimates. In contrast, if white turnout is lower than black turnout, then the single equation method will usually yield estimates of black support for the black candidate that are too high. The double equation method will make the appropriate corrections for differential turnout levels,<sup>80</sup> but now, with black turnout higher than white turnout, the single equation overestimates black support for the black candidate. The double equation estimate of black bloc voting will be lower than the single equation estimate. Thus, sometimes the double equation method yields estimates higher than the single equation method

78. See Appendix.

79. The above hypothetical has white and black eligibles in the same numbers and in a symmetric distribution. The magnitude of the errors in estimated average support for the candidates by race of the electorate generated by use of a single equation estimate will vary with both proportion black and the nature of the distribution of black voters—in particular, whether most districts are or are not racially homogeneous. The exact nature of this interaction is too complex for the present discussion, but the complexities do not affect the accuracy of the general statements made in the text. Of course, if all districts are perfectly racially homogeneous then the single equation method and the double equation method produce identical results.

80. For example, if whites turn out at 50% of eligibles and blacks turn out at 100% of eligibles (the mirror image of our previous example) then (again assuming a uniform distribution on the proportion of the eligible population that is black) and again assuming that voting is, in fact, near perfectly predicted by racial lines (90% of each race voting for the same-race candidate), the single equation method would give us black vote for the black candidate as 97% and white vote for the black candidate as 20%. See *Rejoinder, supra* note 66.

and sometimes the double equation method yields results lower than the single equation method. In general, however, the double equation method yields results closer to the truth than does the single equation method. Thus, Wildgen's charge that double regression "profits its users through ratcheting up slopes"<sup>81</sup> is flatly wrong.

Moreover, Wildgen implies that (1) the only users of ecological regression are experts in court who are testifying for plaintiffs, and (2) that experts testifying for plaintiffs have so little scholarly integrity that they would use methods which they knew produced results favorable to their side (i.e., higher estimates of bloc voting) and then seek to hide that fact from the federal courts while testifying under oath.<sup>82</sup> These implications are similarly mistaken.<sup>83</sup>

### C. Does Ecological Regression Violate Standard Statistical Assumptions?

Several recent attacks on ecological regression are based on the claim that use of linear regression to estimate voting patterns is inappropriate because the data violate the assumptions that justify the use of linear models. The strongest such attack has been offered by Wildgen,<sup>84</sup> who expresses a claim that double regression, by definition, violates the standard assumptions of regression analysis such as uncorrelated errors.<sup>85</sup>

There are numerous flaws in Wildgen's charge. First, Wildgen miscalculates the values he cites as evidence for double regression failures.<sup>86</sup> Second, Wildgen incorrectly asserts that there is no statistical model for the sampling errors in double regression.<sup>87</sup> And third, Wildgen looks at

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81. *Social Alchemy*, *supra* note 63.

82. For example, I have testified for defendant jurisdictions in voting rights cases, including the City of Boston, and the states of Indiana and Rhode Island, as well as for plaintiffs. I use exactly the same methodology regardless for which side I testify. See *MINORITY REPRESENTATION*, *supra* note 3. The same is true for James Loewen, who has also testified both for plaintiffs and for defendants. The methods we advocate have been used by other experts such as Kimball Brace, Ronald Weber, and Harold Stanley, who testify primarily for defendants as well. See *Recent Developments*, *supra* note 5.

83. For additional rebuttal to Wildgen see James W. Loewen, *Sand in the Bearings: Mistaken Criticisms of Ecological Regression*, 22 *URB. LAW.* 503 (1990).

84. See *Social Alchemy*, *supra* note 63.

85. I state this because Wildgen is not very precise in his claims and uses the phrasing that "double regression is not regression" to frame his attack. See *Social Alchemy*, *supra* note 63.

86. See Richard L. Engstrom, *Getting the Numbers Right: A Response to Wildgen*, 22 *URB. LAW.* 495 (1990).

87. Wildgen erroneously asserts that I and other expert witnesses who use double regression (or ecological inference more broadly) lack scientific substantiation for our work and have

the wrong error terms. He does not realize that the relevant errors are those involved in comparing the predicted and the actual candidate vote shares at the precinct level—a comparison that can readily be generated from the information provided by the double equation regressions. When he criticizes the fact that errors in each of the double equations are correlated with the independent variable, he fails to understand that this, rather than being a fault, is actually a justification for the desirability of making use of the double equation method. Such correlated errors occur in part because voter turnout is correlated with race, exactly as anticipated by the model.

More narrowly, various expert witnesses have asserted that particular data sets cannot be modeled through linear methods because of heteroscedasticity.<sup>88</sup> Other reasons given by expert witnesses include that voting behavior of white or black voters is not “constant” across all precincts,<sup>89</sup> and some point estimates of bloc voting levels fall outside the 0 to 100 feasibility range.<sup>90</sup>

First, it is critical to appreciate that only the “average” voting behavior of members of a given group is being estimated. Unless the correlation is 1.00 there will necessarily be some variation across precincts in the behavior of members of the different groups.<sup>91</sup>

Second, it is necessary to remember that statistical models produce *estimates*. The fact that some given point estimate may fall outside the feasible range does not invalidate the methodology, especially if there is a confidence interval around the point estimate that does give estimates in

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not described it in respected social science journals. See *Social Alchemy*, *supra* note 63. This is flatly wrong. For example, shortly after the Supreme Court decision in *Thornburg v. Gingles*, 478 U.S. 30 (1986), and subsequent to publishing *Black Representation*, *supra* note 5, which is probably the first extensive published description of the two-equation method and its rationale, I wrote a technical article with Michael Migalski for *Sociological Methods and Research*, a mainstream sociology journal, in which I reviewed the statistical issues involving correlated error in the double regression methodology and showed that, at least for the data used in *Gingles*, identical results were reached using the method of “seemingly unrelated regressions”—a method designed to cope with multiple equations containing correlated variables. See *Polarized Voting*, *supra* note 71. Wildgen is apparently unaware of the 1988 article. More recently, I have written an extensive discussion of the methodology used to develop and validate ecological regression estimates in the case of *Garza v. County of Los Angeles Board of Supervisors*, 918 F.2d 763 (9th Cir. 1990). Similar work has been done by other scholars, see, e.g., Lichtman, *supra* note 66.

88. See, e.g., *Gomez v. City of Watsonville*, 863 F.2d 1407 (9th Cir. 1988), *cert. denied*, 489 U.S. 1080 (1989) (in which Jerome Sacks provided an expert witness report).

89. See David Freedman’s trial testimony in *Garza*, 918 F.2d 763.

90. See *Social Alchemy*, *supra* note 63.

91. In general, the correlations reported by experts testifying in voting rights cases looking at contests where a viable black candidate is running in a black versus white contest have been very substantial—rarely below .5 and often in the .8 or even .9 and above range.

the 0 to 100 range. Moreover, point estimates outside the feasible range are relatively rare and usually not far outside this range. It is easy to show that slight randomness in the underlying relationships can give rise to hypothetical data sets where (even with double regression) the fitted regressions give us estimates slightly outside the feasible range. Nonetheless, if the data show 108% of the blacks voting for the black candidate, we can be confident that this tells us that black support for the black candidate is very high.<sup>92</sup> To take advantage of the fact that we know vote shares must range between 0 and 100% and to constrain estimates to lie within that range is not "cheating," it is just common sense.<sup>93</sup>

Third, nowhere outside of statistics textbooks are all the assumptions of the standard linear model satisfied. Real-world data sets reporting election results by precinct usually have some correlated error. The fact that certain statistical assumptions are not perfectly met does not mean that the results are incorrect.<sup>94</sup> The basic issue in court, and the issue for social scientists, is whether whites and blacks are each, on average, more likely to vote for candidates of their own race.

Fourth, it is critical for us to appreciate the difference between findings that are substantively significant and those that are merely statistically significant. A statistical demonstration of some nonlinearity certainly ought not to imply that estimates derived from a linear model should be thrown out, since even trivial deviations from a linear model may be statistically significant. Indeed, if there are a large number of precincts (and there were roughly 6000 in Los Angeles County), some statistically significant improvement in fit is almost guaranteed if one moves from a linear model to one with higher order terms.<sup>95</sup>

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92. For a discussion of peculiar counter-examples to this generalization, involving situations with more than one multiple minority group and no homogeneous precincts, where estimates outside the feasible range can be signals of estimation problems that do need to be dealt with, see *MINORITY REPRESENTATION*, *supra* note 3, at ch. 4.

93. An alternative approach would be to use a probit or logit model that constrains results to lie within the (0,1) domain; however, that approach may have other problems, particularly in the interpretability of coefficients.

94. This correlation can be compared to the fact that our bathroom scale isn't perfectly accurate (or that errors might be greater for very small or very large weights). The fact that the scale is not perfectly accurate does not allow us to say that someone shown as weighing 100 pounds can't reliably be thought to weigh a lot more than someone shown to weigh only 10 pounds, or that someone shown as weighing 400 pounds can't reliably be thought to weigh a lot more than someone shown to weigh only 100 pounds.

95. An amusing example of what happens when a statistician fails to be sensitive to this point occurred in the *Garza* trial. Jerome Sacks, a statistician testifying for the defendant jurisdiction, had attacked the linear regression methodology used by experts for plaintiffs (Alan Lichtman and myself) on the ground that he could show that for every election we had analyzed a nonlinear model produced a statistically improved fit to the data. He asserted that

A fifth problem with critiques by statisticians of social science models for failure to perfectly satisfy certain statistical assumptions is that these criticisms may miss some points that are obvious to anyone with political knowledge. For example, in his testimony in *Garza*, statistician Jerome Sacks made a special point about there being statistically significant nonlinearities in the relationship between vote share and percent Hispanic in the electorate for two particular Hispanic candidates. He illustrated these alleged nonlinearities with a scattergram plotting the vote share for each candidate versus percent Hispanic in the electorate. He failed to pay attention to the fact that these candidates were running against one another (as well as against other non-Hispanic white candidates—including a well-financed incumbent). When confronted with a scattergram showing the combined vote share for these candidates versus percent Hispanic in the electorate, his fellow expert witness for the county, Stephen P. Klein, remarked at his deposition that this scattergram did show a linear pattern.

### III. Can Ecological Inference Ever Be Valid?

Those of us who developed the double regression technique were familiar with Robinson's critique of ecological correlations.<sup>96</sup> We were also familiar with subsequent work by Goodman<sup>97</sup> and by Duncan and Davis<sup>98</sup> seeking to define parameters under which valid ecological inference might be possible.<sup>99</sup> Some of the recent attacks on the use of ecological inference in voting rights cases constitute a kind of statistical

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this meant that the linearity assumption was unjustified. As another part of his testimony Sacks had generated a simulation of a linear model with random error. In the pounds of printout he had generated, but which he had not reviewed directly, there was a run in which he applied his test of linearity to his simulated linear data. Confronted with this data run, he was forced to admit on the witness stand that even his own ostensibly linear data would flunk his test for statistically significant non-linearity.

96. See W.S. Robinson, *Ecological Correlations and the Behavior of Individuals*, 15 AM. SOC. REV. 351 (1950).

97. See Leo A. Goodman, *Ecological Regression and the Behavior of Individuals*, 18 AM. SOC. REV. 663 (1953); Leo A. Goodman, *Some Alternatives to Ecological Correlation*, 64 AM. J. SOC. 610 (1959).

98. See Otis D. Duncan & Beverly Davis, *An Alternative to Ecological Correlation*, 18 AM. SOC. REV. 665 (1953).

99. I have subsequently learned that all of the techniques for modifying ecological regression which I had discovered on my own in preparing testimony for *Gingles* and which I thought at the time were original were well known to some other experts. See, e.g., JAMES LOEWEN, *SOCIAL SCIENCE IN THE COURTROOM* (1982) (demonstrating that correlations between the level of support for minority candidates and the percentage minority population were not substitutes for estimates of the actual magnitudes of differences in the levels of minority and non-minority candidates support from the minority and non-minority communities); *Boykins v. Hattiesburg*, No. H77-0062C (S.D. Miss. 1984) (extending the standard ecological

nihilism in which a total or near total impossibility of making reliable inferences about voting patterns by race absent reliable survey data (broken down by race) about how people actually voted in the election at issue is asserted.<sup>100</sup> John Wildgen, for example, in both courtroom testimony and his 1993 article,<sup>101</sup> has attacked inferences based on the matching of support for the black candidate in the various electoral precincts with the (estimated) proportion of the electorate in those precincts that is black.<sup>102</sup> Indeed, David Freedman testified in *Garza* that even a situation where there was a perfect relationship ( $r = 1.0$ ) between minority candidate vote share and minority percentage of the electorate, and in which 0% of the vote in homogeneously (entirely) white/Anglo precincts went to the minority candidate and 100% of the vote in homogeneously (exclusively) minority precincts went to the minority candidate need not be taken as confirmation of racial polarization.

The purist/nihilist position that nothing useful can be said about voting patterns if there are no reliable survey data broken down by race is absurd. Even one of the most severe critics of ecological inference, Jerome Sacks, was willing to acknowledge that, when a substantial percentage of the electorate is located in homogeneous precincts, reliable ecological inference is possible.<sup>103</sup> Moreover, since courts in voting rights cases demand information on racial voting patterns, and reliable exit polls broken down by race are unlikely to be available, the alternative to inferences based on actual election returns is reliance on impressionistic reports from lay witnesses. Alternatively, if barred from reporting actual election returns and inferences based on them, minority plaintiffs would effectively be barred from ever protecting their rights in court.

Wildgen has charged that "courts do not worry about the ecological fallacy because Professor Grofman convinced the Supreme Court it is not a problem."<sup>104</sup> This claim is highly misleading. First, while it is true that *Gingles* gave additional legitimacy to the use of homogeneous precinct analysis and ecological regression as appropriate techniques to esti-

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regression methodology for racial bloc voting to deal with the case of multiple minority candidates).

100. See Freedman et al., *supra* note 6, at 701 ("without survey data there may be no reliable answers to questions about ethnic voting behavior.").

101. See *Social Alchemy*, *supra* note 63.

102. For example, Wildgen attacks double regression as committing the ecological fallacy "twice." See *Social Alchemy*, *supra* note 63.

103. In his trial testimony in *Garza v. County of Los Angeles*, No. CV 88-5143/5435 KN(Ex) (C.D. Cal. Jun. 24, 1990).

104. See *Social Alchemy*, *supra* note 63.

mate the levels of white and black support for particular candidates in the absence of reliable survey data for the relevant elections, it is important to remember that these methods, especially the former, had already been ubiquitous in the many cases involving findings about polarization decided before *Gingles*.<sup>105</sup> Second, judges decide cases on case-specific facts and rely on a variety of types of evidence, as well as their own background knowledge. Thus, while the potential reliability of ecological inference probably is no longer an issue, since even the most extensive general attacks on ecological inference such as those raised in *Garza* have been decisively rejected by recent trial courts, the appropriateness of any specific data analysis using ecological regression is still subject to challenge.<sup>106</sup>

When used with the proper checks and safeguards, ecological regression has shown its reliability and has withstood severe attacks, not just from Wildgen, but also from a number of other social scientists and statisticians.<sup>107</sup> In several recent cases courts have responded to statistical criticisms of standard methods of ecological regression and homogeneous precinct analysis by taking the common sense view that the "inter-ocular" test is the one irrefutable statistical test. In essence, when you look at tables or graphs showing the relevant election data, and the pattern of polarization jumps up and hits you between the eyes, then there is polarization, esoteric quibbles to the contrary notwithstanding. This view has been expressed most directly by a federal district court in *Jeffers v. Clinton*.<sup>108</sup>

### A. The So-Called Neighborhood Model

The most extensive and seemingly most methodologically sophisticated attack on the general unreliability of ecological inference in the voting rights context has been that associated with the development of

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105. See *Expert Witness*, *supra* note 13.

106. Of course, it is unlikely that misleading attacks on inferences drawn from ecological regression and homogeneous case analysis that have already been considered and rejected by trial courts, e.g., attacks such as those made by Wildgen, will be successful in the future.

107. See MINORITY REPRESENTATION, *supra* note 3, at ch. 4.

108. 730 F. Supp. 196, 208 (E.D. Ark. 1989). The court noted that "exhibit after exhibit was introduced in the form of 'scattergrams,' in which the votes for black and white candidates are plotted for various precincts. To our untrained eye, the cumulative effect of these exhibits is overwhelming, whatever the technical merits or demerits of the various statistical theories. And our own experience as citizens of this State, which we are not required to lay aside, strongly confirms this conclusion." *Id.* I have argued in favor of the importance of the inter-ocular test in *Rhode Island Bd. of Elections v. Superior Court*, CA No. 82-1727 (R.I. 1982). Of course, we must be careful to apply the inter-ocular test in a sensible fashion.

the so-called neighborhood model.<sup>109</sup> The neighborhood model is intended as an alternative to standard homogeneous precinct and ecological regression analysis. Its basic assumption is that, within any given precinct, whites and blacks (Hispanics and non-Hispanics) vote alike. The neighborhood model uses this assumption to develop estimates of white and black support for each candidate that are, respectively, simply the average vote for a candidate in a precinct weighted by the minority and non-minority share of the vote in each precinct.<sup>110</sup>

One of the more remarkable features of the neighborhood model is that, in the guise of a critique of ecological inference, it is itself a classic example of the ecological fallacy. Indeed, what could be a more pernicious example of an invalid ecological inference than believing that what was true of an ecological aggregate (such as a precinct) must be true of everyone within it? The other major flaw in the neighborhood model is that, no matter what the distribution of Hispanic voters, the neighborhood model will always find less polarization than is present unless there is no polarization whatsoever.<sup>111</sup>

The neighborhood model is a prisoner of the distribution of minority population. In county-wide elections in Los Angeles, given the spatial distribution of Hispanic voters, it is mathematically impossible for the neighborhood model to show polarization greater than about 60-40. Indeed, in Los Angeles County as a whole, if 100% of Hispanics are voting one way and 100% of non-Hispanics are voting the other way, the neighborhood model will estimate that the split is 41-8 rather than 100-0. Therefore, even in this extreme case it will not find voting to be polarized. Thus, for any county-wide election in Los Angeles, the neigh-

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109. See Freedman et al., *supra* note 6. The neighborhood model was developed by Drs. Freedman, Sacks, and Klein. It was introduced by Freedman in his testimony in *Garza*. I refer to it as "so-called," because the link between an electoral precinct and a neighborhood is far from straightforward. Precincts are arbitrary units of aggregation that might mix populations with very different characteristics who may live in proximity to one another but who do not count themselves as living in the same "neighborhood" in the more sociological sense of that term. How geography is aggregated into precinct units affects the predictions of the neighborhood model. See Lichtman, *supra* note 66.

110. Because the neighborhood model was offered by well-known statisticians and because it offers the most radical alternative to the now standard ecological regression and homogeneous precinct methodology we shall devote more attention to it in this paper than it deserves. The neighborhood model was resoundingly rejected by the trial court in *Garza* and it has severe theoretical and practical flaws, any one of which would be fatal.

111. See Lichtman, *supra* note 66. When voting is polarized, unless the minority and non-minority populations are perfectly segregated with respect to residence, the neighborhood model makes the voting behavior of minority and non-minority voters resemble one another. The less the spatial segregation the less is the neighborhood model able to detect polarization because it forces the behavior of the two groups to converge.



neighborhood model is useless as a diagnostic tool, since it is essentially guaranteed to find no polarization.<sup>112</sup>

Incredibly, the only time it was mathematically possible for the neighborhood model to find polarization in a county-wide race in the County of Los Angeles given the 1980s' distribution of Hispanic votes was when there is only bare polarization.<sup>113</sup>

In their 1991 article *Ecological Regression and Voting Rights*, Drs. Freedman, Klein, and Sacks reviewed ten county-wide contests or referendum votes for which exit poll data and neighborhood model estimates were compared to Hispanic voters.<sup>114</sup> If the authors had provided the data on non-Hispanic voting in these contests, it would be obvious that in all but one of these contests the neighborhood model finds voting not to be polarized. Yet in four of these contests the exit poll shows voting to be polarized. In other words, the neighborhood model is wrong three times out of ten for the data. It always failed to find polarization when voting was severely polarized. The only polarized referendum vote where the neighborhood model found polarization is the least polarized contest of the four. For county-wide contests in Los Angeles County, the neighborhood model is a fire alarm that never rings if there is a serious fire even though it might go off if someone dropped a match in a nearly empty wastebasket.

The authors assert that the neighborhood model fits the Los Angeles exit poll data better than does ecological regression.<sup>115</sup> To reach that conclusion, they have to neglect the clear evidence that it is unable to detect severe polarization in county-wide contests and understates polarization in general. They also have to treat referenda on tort law reform, carcinogenic warnings, etc., as being as informative about bloc voting as elections contests involving viable Hispanic candidates or issues of particularized concerns to Hispanics.<sup>116</sup> But, in the most relevant elections

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112. In 1990 a significant proportion of the Hispanic electorate in Los Angeles County lived in precincts that were heavily non-Hispanic. In the neighborhood model, the voting behavior of these Hispanic voters would be assimilated to the behavior of the non-Hispanic voters who comprise the vast bulk of the electorate in those precincts. Thus, the neighborhood model is guaranteed to perform poorly given the population distribution of Hispanic and non-Hispanic voters in the Los Angeles County electorate. In contrast the standard method can, at least in principle, detect polarization regardless of the nature of residential segregation, at least as long as there is sufficient variance in the distribution of members of each group across precincts. Grofman Trial Testimony in *Garza v. County of Los Angeles*, Civ. No. CV 88-5143/5435 KN (Ex) (C.D. Cal. 1990).

113. See Freedman et al., *supra* note 6.

114. Freedman et al., *supra* note 6.

115. Freedman et al., *supra* note 6, at 692-94.

116. *Gingles* and subsequent cases make it clear that the elections that are most directly

about which exit poll data was available for discussion at the trial (the reelection of Hispanic California Supreme Court Justice Cruz Reynoso and the referendum on English as an official language) the neighborhood model failed to detect polarization even though voting in both situations was, according to exit poll data, polarized along Hispanic versus non-Hispanic lines.<sup>117</sup>

The neighborhood model is on its face empirically implausible when applied to the type of elections that were at issue in the Los Angeles County case, namely non-partisan elections involving Hispanic and non-Hispanic candidates. The idea that Hispanics and non-Hispanics in a given neighborhood would vote identically in such contests is politically naive.

Although the arguments in Dr. Freedman's 1991 article largely replicate points made by Drs. Freedman, Klein, and Sacks on behalf of the County of Los Angeles in trial testimony, they omit from their article some important qualifications to their negative view of ecological regression and their positive view of the neighborhood model that are quite important.<sup>118</sup> In particular, in trial testimony:

- (1) Dr. Freedman recognized that ecological regression at least sometimes gets the right answer even if the so-called constancy assumption is not satisfied.<sup>119</sup>

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relevant to an assessment of bloc voting are those with viable minority candidates in a genuine contest against non-minority candidates or where there are issues uniquely involving the particularized interests of the minority community.

117. In my view, the litmus test for the accuracy of ecological regression in any jurisdiction is whether it accurately tells us whether voting is or is not polarized along Hispanic/non-Hispanic lines in contests that are potentially legally relevant to a finding of polarization in the contest at issue, namely those involving a viable Hispanic candidate pitted against a non-Hispanic candidate, or issues of uniquely particularized concern to Hispanics. Moreover, because the supervisorial contests are nonpartisan, we would pay special attention to voting patterns in contests without a party cue. But, in the two elections (the Reynoso reelection and the English as an official language referendum) that most nearly match our conditions, county-wide ecological regression results perfectly match those from exit polls for both Hispanic and non-Hispanic voters. While these two elections are the most relevant of those for which we have exit poll data, I, like Dr. Lichtman in his trial testimony in *Garza*, would emphasize that they are not elections pitting a viable Hispanic candidate against one or more non-Hispanic candidates in a setting where party is not a voting cue. It is the latter situation in which I would expect voting to be most heavily polarized along Hispanic versus non-Hispanic lines.

118. Omission of these views leaves the reader of their 1991 article with a very misleading picture of why the arguments made in it have been rejected by the present author (and by the *Garza* trial court).

119. Q. Is it your position that the ecological regression model can make reasonable estimates of voting behavior even if its assumptions are wrong to a considerable degree?

A. I think we have some examples of that, yes.

Q. And what would those examples be?

(2) Dr. Sacks recognized the validity of ecological regression methods for any group 35-40% or more of whose members are located in homogeneous precincts.<sup>120</sup>

(3) Dr. Klein acknowledged the fact that, in county-wide races in Los Angeles County, the neighborhood model is effectively useless in detecting substantial polarization were it to be present.<sup>121</sup>

(4) Although the three authors have asserted that their "neighborhood" model is better than ecological regression, that does not mean that they think the neighborhood model is any good. On this point the courtroom testimony of Drs. Freedman, Klein and Sacks is far more revealing than the positive comments about the neighborhood model found in their 1991 article. At trial all three characterize the neighborhood model as unreliable.<sup>122</sup>

A. I think some of exit poll data is like that.

Trial record at 116, *Garza v. County of Los Angeles*, Civ. No. 88-5143/5435 KN (Ex) (C.D. Cal. 1990) (Freedman cross-examination).

120. One would never know from reading their article that one basis of the trial court's finding that non-Hispanic voters failed to provide significant support to Hispanic candidates was the court's reliance on "Dr. Sacks' analysis . . . of five test cases of the reliability of the regression analysis for non-Hispanics" that met Dr. Sacks' own threshold for a sufficiently high proportion of non-Hispanics living in homogeneous non-Hispanic precincts to be able to treat the homogeneous precinct results as reliable indicators of non-Hispanic voting. *Id.* at 95. After a lengthy interchange about how high a proportion would have to live in homogeneous precincts that I will not bother to reproduce, the following colloquy occurred between Dr. Sacks and Judge Kenyon in the Los Angeles trial:

THE COURT: If you have high homogeneity, then are you saying that in that situation ecological regression—in that situation will produce reliable results.

THE WITNESS: Well, I think it produces exactly the same results or very close—not exactly, but very close to the same results that the homogeneous precincts do, so that they go hand in hand.

THE COURT: And in that situation it is reliable.

THE WITNESS: That's correct.

*Id.* at 108 (March 13, 1990).

121. Asked about the ability of the neighborhood model to reproduce an 80/20 split county-wide (80% of the Hispanics voting for the Hispanic candidate(s) and 20% of the non-Hispanics voting for the Hispanic candidate(s)), Dr. Klein replied, "[i]t wouldn't be able to detect the 80/20 split you're describing." *Id.* at 20 (March 8, 1990) (Klein cross-examination). Asked whether it could detect a 70/30 split in a countywide election, Dr. Klein replied, "I think it would be tough for the neighborhood model to catch something like that." *Id.* at 20.

122. For example, Dr. Freedman answered:

Q. *And you do not believe that the neighborhood model is a reliable way to estimate the voting behavior in Los Angeles County; isn't that right?*

A. *Right.* Its only advantage is comparative.

*Id.* at 115 (emphasis added).

Dr. Sacks' views on the unreliability of the neighborhood model parallel those of Dr. Freedman. On his direct testimony the following interchange occurred:

Q. Did you create the neighborhood model for the purpose of proving anything about polarized voting?

A. No. Not to—as a technique which will be a reliable detector of polarized voting, I don't think that this particular one is such.

*Id.* at 61 (emphasis added).

Similarly, while in his direct testimony Dr. Klein does assert that "it's my opinion that

## B. Empirical Validation of Ecological Regression

In contrast to the abysmal performance of the neighborhood model when matched against exit poll data in the reelection of Justice Reynoso or the referendum on English as an official language, ecological regression estimates for these contests are virtually identical to the county-wide exit poll estimates for Hispanic and non-Hispanic voting patterns. Similar concordance between exit poll data and ecological regression estimates in contests involving minority votes for a minority candidate of the same ethnicity who was the minority candidate of choice are found in recent work by James Loewen.<sup>123</sup> Moreover, almost none of the data provided by Drs. Freedman, Klein, and Sacks purporting to demonstrate the unreliability of ecological regression involves elections with Hispanic candidates or referenda with issues involving the particularized interests of the Hispanic community.<sup>124</sup> Even in situations where there is no reason to expect race (or in this case, Hispanic origin) to be a major factor, e.g., the referendums about carcinogenic warnings, tort law reform, nuclear freeze, or gun control, ecological regression did correctly show voting to be polarized in the contest where the exit poll gives rise to that conclusion. Ecological regression also showed no polarization in the

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the neighborhood model is better than ecological regression . . . [.]” *id.* at 46, elsewhere in Dr. Klein’s testimony, in responding to a question from the court, he makes it clear that this does not mean that he actually has a high opinion of the neighborhood model. To the contrary:

Q. THE COURT: What good is it?

A. We can see whether this model works better than ecological regression. *You think that this model is not very good and I agree with you.* But what we could see is whether or not it works any better.

*Id.* at 24 (emphasis added).

Later in his testimony Dr. Klein is even more emphatic about his low opinion of both ecological regression *and* the neighborhood model:

Q. Dr. Klein, based on the various reality tests that you’ve described for us this morning, what conclusions do you draw about the relative accuracy and reliability of the ecological regression model as compared to the neighborhood model?

A. [The] neighborhood model always won, *but I think that basically they’re unreliable.*

Q. *Both of them?*

A. *Both of them.*

*Id.* at 108A (emphasis added).

Not surprisingly, in the light of all the testimony, the district court in *Garza* concluded that the neighborhood model is “not a reliable method of inferring group voting behavior.” *Garza*, No. CV 88-5143 KN (Ex), slip op. at 87.

123. See Loewen, *supra* note 70.

124. Freedman et al., *supra* note 6, at 697. One of the many errors made by Drs. Freedman, Klein and Sacks in their courtroom testimony was to treat all elections as essentially equally informative about probable polarization in the matter at issue, namely probable polarization in a non-partisan supervisory contest pitting a viable Hispanic candidate against a well-funded Anglo opponent.

contests where the exit polls showed no polarization, albeit there are considerable divergences between the raw values found in the two methods in a number of these referenda.<sup>125</sup>

## Conclusion

Despite the existence in theory of a possibility that ecological regression could overestimate the degree of polarization, statistical issues raised to challenge the accuracy of bloc voting estimates are, in most instances, esoteric quibbles that lack any practical importance. Further, these objections serve mostly to prolong trials and to increase the incomes of expert witnesses for both sides.<sup>126</sup> In the Los Angeles County case, ecological regression was subject to its most severe and extensive attack. It came through with flying colors.

In contrast, one recently proposed rival model, the so-called neighborhood model, is empirically and theoretically implausible on its face. The model failed to detect the polarization shown by Los Angeles County exit poll data in the only two situations for which exit poll data were available where there was either an election with an Hispanic candidate or a referendum of unique concern to Hispanic voters. More generally, the neighborhood model is mathematically flawed because it has a high probability of giving rise to a Type II fallacy in accepting the null hypothesis of no polarization when it is false. This is so because it always understates the amount of polarization except when there is no polarization whatsoever. Moreover, under certain not implausible circumstances (circumstances that did in fact occur in Los Angeles County) the neighborhood model essentially always gives the same answer (no polarization) for elections in a given jurisdiction regardless of the facts. Thus the neighborhood model is simply not useful as a diagnostic tool.<sup>127</sup> When used with care and with attention to the various doublechecks described in the published literature, ecological regression, complemented by ho-

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125. If we reclassify the one exit poll among the ten elections and referenda in Table 2 where Freedman et al., *supra* note 6, wrongly claim that ecological regression results show polarization but I would conclude that there was no polarization, and look at results comparing ecological regression and exit poll data for that election plus the nine remaining polls, we find that ecological regression shows a majority of Hispanics voting oppositely from a majority of non-Hispanics in all five instances where the exit poll data show that to be the case, and shows the two groups voting in the same fashion in the remaining five elections in which the majority of Hispanics are shown by exit poll data as voting the same as the majority of non-Hispanics; i.e., ecological regression gets it right ten out of ten times, and gets it right both when voting is polarized and when it is not.

126. See *Statistics*, *supra* note 61.

127. For a powerful critique of the neighborhood model and a demonstration of its failure in setting outside Los Angeles County, see Loewen, *supra* note 70.

mogeneous precinct analysis, is a reliable tool for measuring bloc voting.<sup>128</sup> This is a conclusion that numerous courts have come to, including the trial court in the Los Angeles County case.<sup>129</sup> It is the correct conclusion.<sup>130</sup>

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128. Of course, a *mechanical application* of ecological regression methodology *without an understanding of its basic logic* and *without attention to any accuracy checks* could lead to error in some very special circumstances; but even in such situations, if there actually are problems with drawing reliable inferences from the standard methodology in a particular election, they will be revealed by failure to achieve satisfactory correlations or statistical significance, or by failure of one or more of the other doublechecks. For a discussion of accuracy checks, see *Black Representation*, *supra* note 5; *Polarized Voting*, *supra* note 71; *Recent Developments*, *supra* note 5.

129. For example, in *Garza*, the citywide ecological regression estimates, based on double regression, and the citywide exit poll data were essentially indistinguishable. This was one of the many reasons that the testimony of Allan Lichtman and myself in that case about minority voting patterns was found to be far more credible than the nay-saying and doubt-raising of the several statisticians and social scientists who testified at great length for the County. See *Statistics*, *supra* note 61; Lichtman, *supra* note 66.

130. The double regression methodology improves upon the single equation approach found in Goodman, *supra* note 97, and complements both the commonsensical approach of homogeneous case analysis and the seemingly more sophisticated overlapping percentages method developed by Duncan, *supra* note 98.

## APPENDIX

### Double Regression Methodology

Let

$x$  = the proportion of total registration which is white;

$1 - x$  = the proportion of total registration which is black;

$P_w$  = the proportion of total registered voters who vote for the white candidate(s);

$P_B$  = the proportion of total registered voters who vote for the black candidate(s);

$T$  = the proportion of registered voters who vote.

These four variables can all be determined directly from election returns, registration data from local election boards, or U.S. census data matched to the precinct level; i.e., their values are, in principle, directly observed.

Let

$P_{ww}$  = the proportion of white registered voters who vote for the white candidate(s);

$P_{Bw}$  = the proportion of black registered voters who vote for the white candidate(s);

$P_{BB}$  = the proportion of black registered voters who vote for the black candidate(s);

$P_{wB}$  = the proportion of white registered voters who vote for the black candidate(s).

The above four variables are unobservable. To ascertain their values, we must make inferences from the variables we can directly observe.<sup>131</sup>

It is true by definition that, for the electorate as a whole, we must have

$$P_w = x(P_{ww}) + (1 - x)(P_{Bw});$$

i.e.,

$$P_w = (P_{ww} - P_{Bw})x + P_{Bw}.$$

Let  $P_w(i)$  = the value of  $P_w$  in the  $i$ th voting precinct, etc.; i.e., in general, we shall use the superscript ( $i$ ) to denote the value of a variable in the  $i$ th voting precinct. If we regress  $P_w(i)$  on  $x(i)$ , then, because of the definitional identity given above, the slope and intercept of the regression line we obtain has a straightforward "natural" interpretation, in terms of

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131. Normally,  $P_{wB} + P_{ww} < P_{BB} + P_{Bw} < 1$ , and  $P_w + P_B < 1$ , since some white and/or some black registered voters may not vote.

the proportion of white (black) registered voters who vote for the white candidate. The regression line can be stated as

$$P_w(i) = m_1 x(i) + b_1.$$

But then, because of the identity that dictates that the vote for a candidate is simply the sum of that candidate's support from black and non-black voters, we must have

$$m_1 = P_{ww} - P_{bw}$$

and

$$b_1 = P_{bw}.$$

We may rewrite the above equations to solve for  $P_{bw}$  and  $P_{ww}$ , to obtain

$$P_{bw} = b_1$$

and

$$P_{ww} = m_1 + b_1.$$

Thus, we can use the precinct level data on observed voting behavior and known minority percentages to estimate the unobservable variables  $P_{bw}$  and  $P_{ww}$ .

Similarly, if we regress  $P_b(i)$  on  $x(i)$ , we obtain

$$P_{wb} = m_2 + b_2$$

and

$$P_{bb} = b_2.$$

Analogously, if we regress  $P_w(i)$  on  $1 - x(i)$ , then we obtain an estimate of  $P_{ww}$  as the intercept of that regression equation; while if we regress  $P_b(i)$  on  $1 - x(i)$ , the intercept of that regression equation gives us an estimate of  $P_{wb}$ . Similarly we can use the sum of the slope of the intercept of each of the equations in this pair of equations to estimate  $P_{bw}$  and  $P_{bb}$ . Mathematically, because of symmetry, it must be the case that the four values we so obtain are identical to those that we obtained from our earlier pair of equations.

Let us specify a new notation such that

$$P'_{ww} = P_{ww}/(P_{ww} + P_{wb})$$

$$P'_{bb} = P_{bb}/(P_{bb} + P_{bw})$$

$$P'_{wb} = P_{wb}/(P_{ww} + P_{wb})$$

$$P'_{bw} = P_{bw}/(P_{bb} + P_{bw})$$

These primed variables, which we obtain by combining the information we derived from the two regression equations  $P_w(i)$  on  $x(i)$  and  $P_b(i)$  on  $x(i)$  to obtain values of  $P_{ww}$ ,  $P_{bb}$ , etc., now give us the estimated white vote for white candidates as a proportion of the total white vote, the black vote for black candidates as a proportion of the total black vote,



etc. The unprimed variables express support for candidates as a proportion of the registrants; the primed variables express support for candidates as a proportion of the voters. It is the latter that are of direct interest; we estimate the former in order to obtain the latter. Of the four primed variables, it is  $P'_{ww}$  and  $P'_{bb}$  in which we shall be most interested, since these denote the proportion of votes from voters which go to candidates of their own race.<sup>132</sup>

### Estimating Turnout

Let

$T_w$  = proportion of white registered voters who vote (i.e., white turnout as a proportion of white registered voters);

$T_b$  = proportion of black registered voters who vote (i.e., black turnout as a proportion of black registered voters).

Our two-equation estimating procedure allows us to estimate (differential) turnout among white and black registered voters,<sup>133</sup> since

$$T_w = P_{wb} + P_{ww}$$

and

$$T_b = P_{bb} + P_{bw}.$$

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132. In QUIET REVOLUTION, *supra* note 2, the further notation is used that

$$P'_w = P_w / (P_w + P_b)$$

and

$$P'_b = P_b / (P_w + P_b).$$

These two primed variables give us the white (black) share of the actual vote. Of course,  $P'_w = 1 - P'_b$ .

133. We could also directly estimate turnout by race (as a proportion of registered voters) by making use of the identity

$$T = T_w x + T_b(1-x),$$

and regressing  $T_w(1)$  on  $x(1)$ . The intercept of this regression will give us an estimate of  $T_b$  while the sum of the slope plus the intercept will give us  $T_w$ . If we did estimate turnout in this fashion, we could then use the  $T_w$  and  $T_b$  parameters so obtained to estimate the number of voters of each race in each precinct and then regress precinct level minority turnout percentages on  $P'_w(i)$  to obtain an alternative estimate of  $P'_{wb}$ , etc. While this approach might seem to be the more straightforward than the one described in the appendix, at least for obtaining an estimate of turnout by race, our experience in analyzing racial bloc voting in hundreds of different elections suggests that the method described in the text for estimating differential rates of turnout by race is usually the more reliable. The reason for that is that the regression equation with turnout as the dependent variable and race as the independent variable will have a very low correlation if average differences in turnout between the races are slight.

