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Research note

Modelling the determinants of swing ratio and bias in US House elections 1850–1980

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ABSTRACT. Electoral data for the US Congress for the period 1850 to 1980 are analyzed. We distinguish two important features of the seats–votes relationship that are often confounded: swing ratio and partisan bias. The swing ratio and electoral bias are shown to be a product of the shape of the constituency partisan distribution (CPD). We confirm earlier research showing that the decline in the congressional swing ratio noted by Tufte (1973) and Calvert and Ferejohn (1984) among others can largely be attributed to a reduction in the number of competitive House seats which has been ongoing for at least 70 years and has, for the entire country, exhibited a near straight-line decline in moving average over virtually the entire period. But, following Gudgin and Taylor (1979), we also show that the swing ratio is responsive to the kurtosis of the distribution of Democratic vote share across congressional districts. Finally, we show that partisan bias is responsive to the skewness of this distribution.

For two-party competition in single-member plurality legislative elections we model the link between a party's mean vote share aggregated across constituencies and its seat share in the legislature as a function of the distribution of partisan voting strength across constituencies (a distribution to which we shall refer, following Gudgin and Taylor (1979), as the constituency partisan distribution (CPD)). We offer a theoretical model that shows how the shape of the CPD should affect the electoral responsiveness (swing ratio) and the asymmetry in the ability of each political party to translate its votes into seats (partisan bias). In contrast to much of the work in the political-geography literature (e.g., Morrill, 1990), we distinguish between two aspects of seats–votes relationships, namely swing ratio and partisan bias. In contrast to much of the work in the political-science literature on seats–votes (e.g., Tufte, 1973; Taagepera, 1986), we focus on the importance of the kurtosis and skewness of the CPD. The data we use to illustrate our model are for

US congressional elections for the period 1850–1980.[1] These data are of some descriptive interest in and of themselves because they are perhaps the longest available time-series for a national CPD.

Following Tufte (1973) we fit a linearized logit regression of the form:

$$\log_e\left(\frac{S}{1-S}\right) = \beta \log_e\left(\frac{V}{1-V}\right) + \alpha + \epsilon \qquad \text{Equation (1)}$$

where S is the (hypothetical) Democratic (two-party) seat share in the legislature elected in a given election, and V is the (hypothetical) Democratic (two-party) vote share in that election, β is the slope, α is the intercept and ϵ is a stochastic error term taken to be of mean zero. (Alternative logit or bilogit specifications of the functional form of this seats–votes equation are given in Lineham and Schrodt, 1978; Browning and King, 1987; and King and Browning, 1987; see also Campagna and Grofman, 1990).

The values of V and S are taken from a hypothetical seats–votes curve derived from the method suggested by Butler (1953). For each election we calculate the increase in seats for each one percentage point increase or decrease in the Democrats' vote share. This calculation gives us a hypothetical curve around the observed vote-share–seat-share values. We have chosen to focus on the points near the observed outcomes, plus or minus ten percentage points in each direction. The only part of the distribution we are really interested in is that in the competitive range since high variance in inter-election shifts caused by uncontested seats becoming contested is essentially irrelevant as long as partisan outcomes in those seats is not at issue (cf. Mann, 1978: 87). Even large changes in vote share will not affect the party control of seats in which a party has been receiving a very high proportion of the vote.

In generating this hypothetical curve we implicitly assume that the inter-election shift in any congressional district equals the average shift plus or minus a term that has mean zero, reflecting random error—an assumption known as uniform swing. On balance, we share the view of Niemi and Fett, (1986) that the Butler method for generating a hypothetical seats–votes curve (Butler, 1953; see King and Browning, 1987; King and Gelman, 1988 for a stochastic extension of the method) is to be preferred to the more commonly used one-point-per-election method of Dahl (1956) and March (1957) that had been in common use until recently. The Butler method allows us to generate estimates of votes–seats relationships for each election and thus to observe changes in the shape of these relationships over time.

Also, when we confine ourselves to competitive seats, the assumption of uniform swing is not unreasonable for our data. Campagna and Grofman (1990) look at the extent to which the assumption of uniform swing subject to only random error is empirically justified for US congressional elections in the 1980s, and find that district inter-election shift appears to be a randomly distributed variable not systematically tied to previous Democratic candidate vote share. Remarkably, for virtually the entire period, when we confine ourselves to competitive seats, the distribution of inter-election shifts is sharply peaked—i.e., most competitive districts do exhibit near identical *percentage point changes* in their level of Democratic candidate support between succeeding election years.[2]

Swing ratio

Our measure of electoral responsiveness is the swing ratio. There are a number of different ways to calculate the swing ratio (Tufte, 1973; Grofman, 1983; Niemi and Fett, 1986). In principle, the *swing ratio* is simply the expected percentage point change in a party's seat share for a one percentage point change in its candidate's mean vote share across all constituencies. The most important fact to understand about the swing ratio is that when the swing ratio is high, small changes in votes can translate into large changes in seats and, conversely, when the swing ratio is low, even large changes in votes may have little effect on the composition of a legislature. Thus, the nature of CPD, the partisan distribution of voting strength, can either mask or exaggerate the strength of national electoral tides. (See especially Grofman, 1982; Gudgin and Taylor, 1979; Johnston, 1979).

One way of thinking about the swing ratio is as the value of the tangent to the seats–votes curve at some given point. It is possible to calculate the swing ratio for any point on the seats–votes curve; it is also possible to calculate mean swing ratio across some set of points (e.g., the set of vote values which comprise the expected range of inter-party competition (see Grofman, 1983)). We use the former approach. In Equation (1) β is taken to be the swing ratio while α is used to determine bias.

Partisan bias

The bias in a seats–votes curve has been differently defined by different authors (see review in Grofman, 1983). We, like Tufte (1973) and Niemi and Deegan (1978), use the term bias to refer to the difference between the seat share that the one party could have expected and the seat share the opposition could have expected to get had each grouping received exactly 50 percent of the two-party vote. If bias is zero, each party is equally efficient in translating its votes into seats. If bias is positive, then Democratic vote strength is more efficiently distributed than that of the opposition.

We calculate bias from the expression given in Equation (1) above.

When $V = 0.5$, $\log_e\left(\frac{V}{1-V}\right) = 0$. Thus, substituting $V = 0.5$ into Equation (1) we obtain

$$\alpha = \log_e\left(\frac{S}{1-S}\right), \qquad \text{Equation (2)}$$

or

$$e^{\alpha}\left(\frac{S}{1-S}\right), \qquad \text{Equation (2)}'$$

or

$$S = \frac{e^{\alpha}}{e^{\alpha}+1} \qquad \text{Equation (2)}''$$

Thus, at $V = 0.5$, since S should be 0.5 if there were zero bias, bias is given by:

$$\left(\frac{e^{\alpha}}{e^{\alpha}+1}\right) - 0.5 \qquad \text{Equation (3)}$$

In general, the bias will be high when the mean and the median of the CPD do not coincide (Gudgin and Taylor, 1979; Johnston, 1979: 63–66). A measure of this discrepancy is the skewness of the distribution. For a distribution whose mean is in the competitive range, in general, positive skew will produce a negative bias. For example, if one party's vote strength is disproportionately found in districts which it lacks sufficient support to

TABLE 1. Congressional election competitiveness measures: whole nation

Year	Congress	Skewness B1	Kurtosis B2	Swing B	Percentage competitive seats	Bias
1850	32	0.1	2.5	5.2	59.4	0.059
1852	33	0.1	1.4	4.1	48.1	0.084
1854	34	0.4	0.6	3.2	30.4	0.047
1856	35	0.7	2.6	3.9	37.4	0.032
1858	36	1.3	2.0	3.8	37.8	-0.060
1860	37	0.6	1.4	3.9	39.2	-0.022
1862	38	-0.8	2.8	4.2	40.7	0.079
1864	39	-1.0	1.2	4.5	32.0	0.070
1866	40	0.3	1.9	4.2	35.3	0.053
1868	41	-0.1	1.6	4.4	41.0	0.037
1870	42	-0.7	2.8	4.4	42.1	0.050
1872	43	-0.1	2.5	4.2	40.6	0.032
1874	44	-0.4	2.9	4.2	40.1	0.023
1876	45	0.7	3.3	4.2	41.5	-0.028
1878	46	0.5	1.1	3.0	28.0	-0.002
1880	47	0.9	3.3	4.2	43.3	-0.014
1882	48	0.0	2.7	4.3	44.4	0.0
1884	49	1.3	2.2	4.1	40.5	-0.067
1886	50	1.2	0.6	3.1	37.8	-0.132
1888	51	1.4	2.7	4.3	43.1	-0.074
1890	52	1.2	1.0	3.7	41.9	-0.081
1892	53	1.3	3.2	4.2	34.0	-0.047
1894	54	0.7	1.6	3.2	23.2	-0.025
1896	55	1.0	1.6	3.6	34.5	-0.028
1898	56	1.0	0.9	3.5	33.0	0.012
1900	57	1.1	1.0	3.1	29.7	0.010
1902	58	0.4	0.1	2.4	24.3	-0.052
1904	59	0.6	0.1	1.9	18.0	-0.089
1906	60	0.5	0.0	2.4	23.6	-0.062
1908	61	0.9	0.5	2.7	27.0	-0.108
1910	62	0.6	0.3	3.2	36.3	-0.057
1912	63	0.8	-0.1	2.3	23.8	-0.103
1914	64	0.7	-0.2	2.1	21.3	-0.103
1916	65	0.6	0.5	2.9	29.2	-0.067
1918	66	0.3	-0.5	2.2	22.1	-0.007
1920	67	0.7	0.1	1.9	15.3	-0.055
1922	68	0.2	-0.3	2.3	23.6	0.042
1924	69	0.6	-0.6	1.7	15.5	-0.012
1926	70	0.5	-0.9	1.5	10.6	0.025
1928	71	0.9	-0.4	2.0	19.6	-0.057
1930	72	0.4	-0.9	2.1	20.4	0.052
1932	73	0.7	-0.8	2.8	30.9	-0.017
1934	74	0.5	-0.6	2.7	28.4	-0.015
1936	75	0.3	-0.3	2.8	24.4	0.027
1938	76	0.5	-0.7	2.2	24.5	0.022
1940	77	0.5	-0.5	2.5	23.1	0.020
1942	78	0.3	-0.7	1.9	18.7	-0.005
1944	79	0.4	-0.4	2.2	21.4	0.012

TABLE 1 (*continued*)

Year	*Congress*	*Skewness B1*	*Kurtosis B2*	*Swing B*	*Percentage competitive seats*	*Bias*
1946	80	0.6	-0.4	1.9	19.4	-0.025
1948	81	0.2	-0.1	2.5	26.5	0.047
1950	82	0.5	-0.6	1.9	20.6	-0.028
1952	83	0.6	-0.5	2.0	19.1	0.042
1954	84	0.6	-0.8	2.1	20.0	0.010
1956	85	0.7	-0.4	2.1	20.7	-0.010
1958	86	0.4	-1.0	2.1	23.8	0.012
1960	87	0.6	-0.6	2.1	19.2	0.010
1962	88	0.8	-0.3	2.1	17.4	-0.005
1964	89	0.4	0.2	2.3	25.1	-0.015
1966	90	0.4	-0.1	1.7	16.8	-0.052
1968	91	0.3	0.0	1.7	15.5	0.007
1970	92	0.2	-0.4	1.3	10.8	0.040
1972	93	0.2	-0.3	1.4	11.7	0.020
1974	94	0.3	-0.7	1.9	20.6	0.030
1976	95	0.1	-0.4	1.6	15.5	0.047
1978	96	-0.1	-0.3	1.6	14.8	-0.001
1980	97	0.0	-0.5	1.5	15.7	0.008

win, that party will not get as many as does the opposing party. The most important point to understand about bias is that it is a measure of asymmetry between the parties in translating votes into seats (Tufte, 1973; Niemi and Deegan, 1978; Grofman, 1983).

We show in *Table 1* competitive seat proportions; mean, skewness, standard deviation and kurtosis of the Democratic CPD; and swing ratio and bias figures for all congressional elections in the period 1850–1980.

For example, if $\alpha = 0.24$, as for 1850 in *Table 1*, then bias is given by

$$\frac{(2.72)^{0.24}}{1+(2.72)^{0.24}} - 0.5 = 0.059$$

Plausibility of estimates

One way to test the plausibility of our seats–votes results is to compare our swing-ratio values with those calculated by other methods. Calvert and Ferejohn (1984: Table 1, 131) provide congressional swing ratios for various historical periods. These values are calculated by a multivariate equation which takes into account effects of presidential 'coat-tails'. Tufte (1973) provides swing-ratio calculations based on the one-point-per-election method. We show in *Table 2* a comparison for our values with those obtained by Calvert and Ferejohn (1984), and by Tufte (1973).

While there are differences, the general pattern of similarities of our results with those from two other methods, when combined with the other arguments in favor of our methodology, gives us confidence that the results we present in *Table 1* are empirically valid.

Determinants of the swing ratio

Almost all the earlier literature on seats–votes relationships has emphasized the link

TABLE 2. A comparison of swing-ratio analyses with the hypothetical seats–votes curve method

Period	*Ferejohn & Calvert (1984)*	*Tufte (1973)*	*Hypothetical seats–votes curve method*
1868–1892	4.63	—	4.23
1896–1928	2.07	—	2.45
1932–1948	3.72	—	2.65
1952–1964	2.24	—	2.13
1968–1980	2.05	—	1.58
1952–1980	2.14	—	1.83
1900–1970	—	2.20	2.27
1868–1970	—	2.52	2.90

between the swing ratio and the standard deviation of the CPD (March, 1957). Following up on insights of Gudgin and Taylor (1979) and Johnston (1979: 62), we would emphasize that the link between the standard deviation and the swing ratio is mediated by the effects of other aspects of the CPD; in particular, by its mean and kurtosis.

If the mean value of the CPD is not in the competitive range, then even a very low standard deviation will not yield a particularly high swing ratio. Moreover, even if the mean value of the CPD is in the competitive range, it is still necessary to distinguish between platykurtic (bell-shaped) and leptokurtic (U-shaped) distributions. Even with a mean of 50 percent and near identical standard deviations, the implications for the swing ratio of leptokurtic and platykurtic distributions are quite different.

Basically, the swing ratio will be high when there are many competitive seats. If the mean is in the competitive range (as was true for US Congressional elections for every year in the entire period 1850–1980, with the exception of the years 1932–1936), then, if the distribution of the CPD is platykurtic, the swing ratio will be low; and if the distribution is normal, the swing ratio will be intermediate in value. The reason for this relationship is that the kurtosis of the CPD is a reasonably good surrogate for the proportion of competitive seats in the distribution for distributions whose median district is in the competitive range.

Our first concern will be with how the changing kurtosis of the CPD affects the swing ratio. *Table 1* shows the shape (kurtosis) of the CPD changing from leptokurtic (peaked) in the 19th century, with positive kurtosis values above 1.0 to platykurtic (dish-shaped) in the 20th century, with negative kurtosis values. Through the 1900 election the kurtosis values are positive each time; 23 of 26 times the value is greater than 1.0, and 13 times the value exceeds 2.0. In the 20th century, 32 times out of 40 the value is negative, and at no time does the value exceed + 0.5. These figures parallel the decline in competitive seats for the same time period.

After the 1910 election, the CPD becomes platykurtic as the number of competitive seats decreases while safe seats increase. Most important for our story is the fact that the swing ratio declines with the change in the CPD from peaked to dish-shaped. In the 19th century the swing ratio is never below 3.0, while in the 20th century the swing ratio exceeds 3.0 only once (1910) and is below 2.0 fifteen times. Since the shape of the CPD determines the swing ratio, it is clear why a competitive party system with about 40 percent of all seats decided by five percent or less would have a higher swing ratio than would a system where only about 20–25 percent of seats were decided by five percent or less.

The matrix of bivariate correlations between proportion of competitive (45–55 percent) seats, proportion safe (>62.5 percent) seats; various features of the CPD distribution such as the mean Democratic vote, standard deviation, kurtosis and skewness; the swing ratio; and a time variable, election year, were generated to examine key relationships.

For the 1850–1980 period the key findings are that:

1. the swing ratio is almost completely determined by the proportion of competitive seats ($r = 0.91$);
2. the proportion of competitive seats correlates higher with kurtosis than with standard deviation (0.76 *v.* − 0.63);
3. the swing ratio correlates marginally higher with kurtosis than with standard deviation (0.87 *v.* − 0.83), but can be very well explained by either; and
4. as is well known, over the entire period there is a strong long-run downward time trend in the proportion of competitive seats ($r = -0.75$), and, accordingly, in the swing ratio ($r = -0.81$) and in the kurtosis ($r = -0.68$).

A full theoretical model of the swing ratio would include kurtosis, standard deviation of the CPD, mean competition levels and such time-dependent variables as changes in the party system. We hypothesize that the swing ratio will be higher the closer the mean Democratic vote share is to 0.50. We operationalize this with a variable, mean competition, which is the difference between mean Democratic vote share across constituencies and 0.50. Secondly, we hypothesize that, if mean Democratic vote share is near 0.50, the standard deviation should be negatively related to the swing ratio. Third, for a mean Democratic share near 0.50 holding standard deviation constant, we hypothesize that the degree of kurtosis (peakedness) of the distribution should be positively related to the swing ratio.

The following regression was run:

$$\text{Swing Ratio} = a + b_1\,(\text{kurtosis}) + b_2\,(\text{standard deviation}) + b_3\,(\text{mean competition}) + b_4\,(\text{a counter variable for time}).$$

This regression shows exactly the posited relationships. The r^2 for the regression was 0.89, and each variable had the expected sign. That is, kurtosis was positively and significantly related to swing ratio while both mean vote and standard deviation were negatively related, with mean vote being significantly related to the swing ratio. The counter variable for time was significantly and negatively related to the swing ratio, indicating secular decline in swing ratio.[3]

Determinants of bias

Values of partisan bias for the period 1850–1980 are also shown in *Table 1*. We expect that bias and skewness should be negatively correlated since there will be partisan bias when the median district does not exhibit the mean vote, and this is indeed what we find: $r = -0.67$.

Note that skewness was negative after the Civil War and became positive with the full readmission of Southern states in 1876–77, and then stayed positive with only a handful of exceptions thereafter. Bias, similarly, was negative just before the Civil War, became positive (pro-Democratic) during the war period and became negative in 1876, but remained that way until 1920. After 1920, the pattern of bias was an irregular one. However, with some exceptions, in the period 1966–1980, bias has been positive even though skewness is also positive, albeit low.

The swing ratio has to do with the rate at which changes in votes get translated into seats; the bias has to do with asymmetries in the way the seats–votes curve treats the two parties. We believe it important to distinguish these two features of seats–votes relationships. For example, bias was identical in 1854 and 1976; yet the swing ratio in the former was 3.2 and in the latter it was exactly half that, 1.6. Similarly, the swing ratio was identical in 1904 and 1974; yet the bias in these years was very different. In our definition, bias is in principle independent of swing ratio or proportion of competitive seats, even if empirically these variables may be correlated. In fact over the whole time period, bias is essentially uncorrelated with the swing ratio ($r = 0.13$) or with the proportion of competitive seats ($r = 0.01$).

Conclusions

The principal intended contribution of this note is to the theoretical understanding of how seats–votes relationships can best be modelled. We have emphasized that swing ratio and partisan bias tap quite different features of seats–votes relationships. One is a measure of electoral responsiveness; the other a measure of asymmetry in the ability of a given party to translate its votes into seats. Both measures are needed.

Our principal empirical results are that, in US congressional elections for 1850–1980, the swing ratio can be almost perfectly modelled as a linear function of the proportion of competitive seats or of the kurtosis of the constituency partisan distribution,[4] and that partisan bias is highly associated with skewness of the constituency party distribution.

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Notes

1. We use the Democratic CPD because the Democratic party ran candidates in over 98 percent of all districts over the entire time period. This, of course, includes the Civil War era when the Democrats almost won control of the House in 1872. In the 19th century some House members were elected from multi-member districts—the inclusion of which could distort the results. We ran the data both ways, excluding and including these districts, and there were only minor diffferences in results. The results shown exclude multi-member districts.
2. The peakedness of the distribution of the inter-election shifts across constituencies is measured by the kurtosis of the distribution. Technically, kurtosis measures the thickness of the tails of a distribution. The higher the kurtosis of this distribution, the more the distribution has all of its probability concentrated at one modal value. A normal distribution has a kurtosis of zero. From 1850–1980 the distribution of the vote shift is leptokurtic (greater than normal) in each election save the 1938–40 election pair. On only three occasions (none since 1928) has the kurtosis of the distribution of the swing vote fallen below 1.0, and in the 20th century the mean value of the kurtosis of the swing is over 1.0.
3. Including an interaction term for 'mean vote times kurtosis' (since when either is not present the swing ratio should be lower) yielded the expected negative value, but it was significant only at the 0.10 level.
4. In non-Southern states the kurtosis values remain high until the 1918 election—24 of 34 elections prior to 1918 had a kurtosis value of over 2.0, and the values are as high as 7.7 (*Table* omitted). Elsewhere (Brady and Grofman, 1990 forthcoming; cf. Archer and Taylor, 1981) we have looked at a sectional decomposition of seats–votes results and found the decline in swing ratio occurred first in the South but is later mirrored in the non-South. Our analysis of kurtosis supports that view.

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