The Electoral College and Presidential Resource Allocation

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1. Introduction

This paper explores how the Electoral College shapes incentives for presidential candidates to allocate resources across states. It does so by developing a probabilistic voting model of electoral competition under an Electoral College system. The model delivers a precise recommendation for how presidential candidates, trying to maximize the probability of gaining a majority in the Electoral College, should allocate their resources. If the Electoral College shapes presidential incentives, then this should be most stark in a presidential campaign. Therefore, the model first applied to the 1988-2000 presidential campaigns. Although important for the political system, the direct effect of campaign spending on people's welfare is limited. Therefore the model is used to test whether the Electoral College distorted the distribution of federal civilian employment 1948-1996. The empirical evidence suggests that the Electoral College system influenced the actual allocation of campaign resources and federal employment. Having established that the model has some empirical plausibility, the paper goes on to analyze the effect of an institutional reform: the transition to a direct national vote for president.

2. Model

2.1. Players and strategies

Two presidential candidates, indexed by superscript R and D, select the number of days, d_s, to campaign in state s, subject to the constraint

$$\sum_{s=1}^{S} d_s^J \leq I,$$

$J = R, D$. (In later applications, the resources, d_s, will denote federal employment or spending.) There is a continuum of voters, each indexed by subscript i, a mass n_s of which live in state s. The voters are affected by campaigning in their state, d_s, and some exogenous characteristics of the parties, captured by parameters R_i, D_i, η_s, and η. The parameter R_i represent an individual-specific ideological preference in favor of party R, and η_s and η represent the general popularity of candidate R. The voters may vote for candidate R or candidate D, and voter i in state s will vote for D if

$$\Delta u_s = u_s\left(d_s^D\right) - u_s\left(d_s^R\right) \geq R_i + \eta_s + \eta. \tag{2.1}$$

2.2. The approximate probability of being president

At the time when the campaign strategies are chosen, there is uncertainty about the popularity of the candidates at the election. The candidates know that the S state level popularity parameters, η_s, and the national popularity parameter, η, are independently drawn from cumulative distribution functions $G_s = N(0, \sigma_s^2)$, and $H = N(0, \sigma^2)$ respectively, but they do not know the realized values.

The distribution of ideological inclinations, R_i, among voters i living in state s is $F_s = N\left(\mu_s, \sigma_{fs}^2\right)$. Thus, the share of votes that candidate D receives in state s is

$$F_s(\Delta u_s - \eta_s - \eta).$$

This candidate wins the state if

$$F_s(\Delta u_s - \eta_s - \eta) \geq \frac{1}{2},$$

or, equivalently, if

$$\eta_s + \eta \leq \Delta u_s - \mu_s.$$

The probability of this, conditional on the aggregate popularity η, and the campaign visits, d_s^D, and d_s^R, is

$$G_s\left(\Delta u_s - \mu_s - \eta\right).$$

Let v_s be the number of votes of state s in the electoral college. Define stochastic variables, D_s, indicating whether D wins state s

$$\begin{aligned} D_s &= 1, \text{ with probability } G_s \\ D_s &= 0, \text{ with probability } 1 - G_s \end{aligned}$$

The probability that D wins the election is then

$$P^D\left(d^D, d^R, \eta\right) = \Pr\left[\sum_s D_s v_s > \frac{1}{2}\sum_s v_s\right]. \tag{2.2}$$

Since the η_s are independent, so are the D_s. Therefore by the Central Limit Theorem of Liapounov,

$$\frac{\sum_s D_s v_s - \mu}{\sigma_E}$$

where

$$\begin{aligned} \mu &= \mu\left(d^D, d^R, \eta\right) = \sum_s v_s G_s\left(\Delta u_s - \mu_s - \eta\right) \qquad (2.3) \\ \sigma_E^2 &= \sigma^2\left(d^D, d^R, \eta\right) = \sum_s v_s^2 G_s\left(\cdot\right)\left(1 - G_s\left(\cdot\right)\right). \end{aligned}$$

is asymptotically distributed as a standard normal. Using the asymptotic distribution, the approximate probability of the democrats winning the election is

$$P^D\left(d^D, d^R, \eta\right) \approx \Phi\left(\frac{\frac{1}{2}\sum_s v_s - \mu}{\sigma_E}\right).$$

In the analysis below, this approximate probability of winning the election will be used, yielding analytic solutions.

2.3. Optimal presidential candidate strategies

Candidate D maximizes the probability of winning the election

$$\max_{d^D} P^D\left(d^D, d^R\right) = \max_{d^D} \int P^D\left(d^D, d^R, \eta\right) h\left(\eta\right) d\eta$$

subject to the constraint

$$\sum d_s^D = I.$$

Candidate R also maximizes his or her probability of winning. Provided that this problem satisfies the concavity conditions, the equilibrium is characterized by the following proposition.

Proposition 2.1. *A pair of strategies for the parties* $\left(d^D, d^R\right)$ *that constitute a NE in the game of maximizing the expected probability of winning the election must satisfy* $d^D = d^R = d^*$, *and for all* s *and for some* $\lambda > 0$

$$Q_s u_s'\left(d_s^*\right) = n_s \lambda, \tag{2.4}$$

where

$$Q_s = -\int \frac{\partial P^D\left(d^D, d^R, \eta\right)}{\partial \Delta u_i} h\left(\eta\right) d\eta$$

From a slightly simplified expression of Q_s, it appears that it measures the joint "likelihood" of a state being pivotal in the electoral college and having a close election. To further estimate and discuss the properties of Q_s, the model is now applied to the problem of allocating campaign resources. The idea is to first estimate the distribution of surprises in election outcomes. This is done by studying the difference between election forecasts in September and outcomes. This distribution of surprises is then used to get an estimate of Q_s.

3. Empirical applications

3.1. Campaign resources 2000

In equilibrium, both candidates will choose the same allocation, so that $\Delta u_s = 0$ in all states. The Democratic vote-share in state s at time t then equals

$$y_{st} = F_{st}\left(-\eta_{st} - \eta_t\right).$$

Inverting and noting that $F^{-1}(y) = \sigma_{fs}\Phi^{-1}(y) + \mu_{st}$ where $\Phi^{-1}(y)$ is the inverse of the standard normal distribution we find that

$$\Phi^{-1}(y_{st}) = \gamma_{st} = -\frac{1}{\sigma_{fs}}\left(\mu_{st} + \eta_{st} + \eta_t\right). \tag{3.1}$$

For now, assume that all states have the same variance of preferences, $\sigma_{fs}^2 = 1$, and the same variance in state-specific shocks, σ_s^2.[1] The election outcome, γ_{st}, is then normally distributed with mean $-\mu_{st}$, and variance $\sigma^2 + \sigma_s^2$.

Further assume that the mean of the preference distribution, μ_{st}, depends on lagged, and twice lagged, votes and a set of variables X_{st} , so that the estimated equation is

$$\Phi^{-1}(y_{st}) = \gamma_{st} = -\left(\beta X_{st} + \delta_1 \gamma_{st-1} + \delta_2 \gamma_{st-2} + \eta_{st} + \eta_t\right). \tag{3.2}$$

The variables in X_{st} are basically those used in Campbell (1992). The national variables are: trial-heat polls from early September; second quarter economic growth; incumbency; and incumbent president running for re-election. The state variables for 1948-1984 are: lagged and twice lagged difference from the national mean of the democratic vote share of the two-party vote share; the first quarter state economic growth; the average ADA-scores of each state's Congress members the year before the election; the democratic vote-share of the two-party vote in the midterm state legislative election; the home state of the president; the home state of the vice president; and dummy variables described in Campbell (1992). After 1984, state-level opinion polls were available. For this period, the state level variables are: lagged and twice lagged difference from the national mean of the democratic vote share of the two-party vote share; the average ADA-scores of each state's Congress members, the year before the election; and state polls, difference from national mean. The other state-level variables were insignificant when state polls were included. The coefficients β and the variance of the state level popularity shocks, σ_s^2, are allowed to differ for when opinion polls were available and when they were not. The equation yields forecasts by early September of the election year. The data-set consists of 672 observations across 50 states and Washington D.C. in the 14 presidential elections between 1948-2000.

The parameters are estimated using maximum likelihood estimation, and the results are shown in Table 1. The standard deviation of the state level shocks after 1984, $\sigma_s = 0.078$, is more than twice as large as that of the national shocks, $\sigma = 0.032$. The average error in state election votes is 3.0 percent and the wrong winner is predicted in 14 percent of the state elections. This is comparable to the

[1] The assumption $\sigma_{fs} = 1$ will be removed in Section (4). The assumption that all states have the same σ_s may also be removed. However, the estimates become imprecise if separate μ_{st}, σ_{fs}, and σ_s for each state are estimated using only 14 observations per state. Therefore, the most restrictive specification will be used for most of the paper.

best state-level election forecast models (Cohen ,1996; Campbell, 1992; Gelman and King, 1993; Holbrook, 1991; Rosenstone, 1983).

3.1.1. Characterization of equilibrium

The equilibrium allocation depends crucially on Q_s. This section discusses what Q_s measures and how it varies across states. From its analytical expression, it seems that Q_s measures the joint "likelihood" of a state being pivotal in the electoral college and having a close election. To see whether this is the case, one million electoral vote outcomes were simulated for each election 1988-2000 by using the estimated state means, and drawing state and national popularity shocks from their estimated distributions. Then the share of elections where a state was pivotal in the electoral college and at the same time had a state election outcome between 49 and 51 percent was recorded. This provides an estimate which should be roughly proportional to Q_s. Figure (3.1), contains these shares on the y-axis and values computed from the analytic expression of Q_s, on the x-axis. The graph on the right contains the same series divided by the state's number of electoral votes. The simple correlation in the diagram to the right is 0.994.

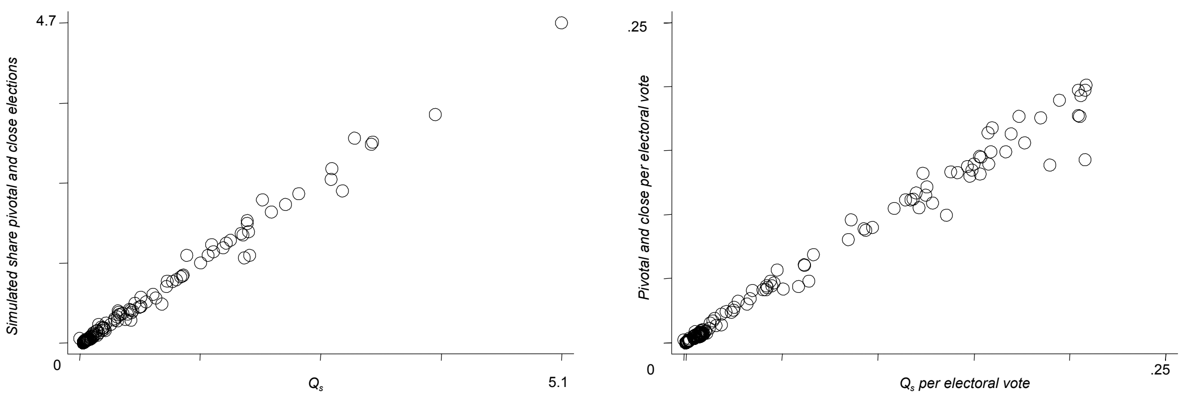

Figure 3.1: Q_s and simulated shares, pivotal and close elections.

To illustrate the discussion of how Q_s varies across states, we will use the year 2000 election, see Figure (3.2). Based on polls available in September 15, 2000, Florida, Michigan, Pennsylvania, California, and Ohio were the states most likely to be pivotal in the electoral college and at the same time have a state election margin of less than 2 percent. This happened in 2.2 to 3.4 percent of the simulations.

The analytic expression for Q_s, explains exactly why some states are more likely to be pivotal and have close elections. First, large states have large Q_s; it is roughly proportional to the number of electoral votes. Second, Q_s per electoral vote, Q_s/EV_s, depends on the expected vote shares in the states, see Figure (3.3).

The main feature of Figure (3.3) is the normal-form shape (solid line). It arises because the candidates try to influence the mean of the electoral vote distribution. To analyze this feature, first define $\widetilde{\eta}$ to be national popularity shock which would lead to expected equal vote shares. Q_s/EV_s is high when

- $\widetilde{\eta}$ is close to zero
- $\widetilde{\eta} + \mu_s$ is close to zero
- μ_s is close to zero.

The first point says that Q_s/EV_s is high when the national election is expected to be close. This is trivial and affects all states in the same way. The second point says that Q_s/EV_s is high for states which have an expected pro-republican bias which is close to the pro-republican shock that would lead to equal expected vote shares. If, for example, the republicans are ahead by 60-40 in the national polls then the candidates should spend a lot in states where the republicans are ahead 60-40. In these states the elections are likely to be close exactly when the election at the national level is close. The third point says that Q_s/EV_s is high for states who have expected elections close to 50-50.

The trade-off between the second and the third effect depends on the size of the national shocks. Q_s/EV_s is at its largest when

$$\mu_s^* = \frac{\sigma^2}{\sigma^2 + (\sigma_E/a)^2}\widetilde{\eta}.$$

The larger the variance of the national shocks, the more important it is to be close to the national shocks. In the extreme case that σ approaches infinity, μ_s^* approaches $\widetilde{\eta}$, and most resources should be spent in states with a 60-40 expected outcome. In the other extreme where $\sigma = 0$, $\mu_s^* = 0$, and most resources should be spent in states with a 50-50 expected outcome. In my estimates the ratio has typically been around 0.5. So, given that the republicans have a 60-40 lead, Q_s/EV_s is highest for states where the republicans lead by 55-45. In September

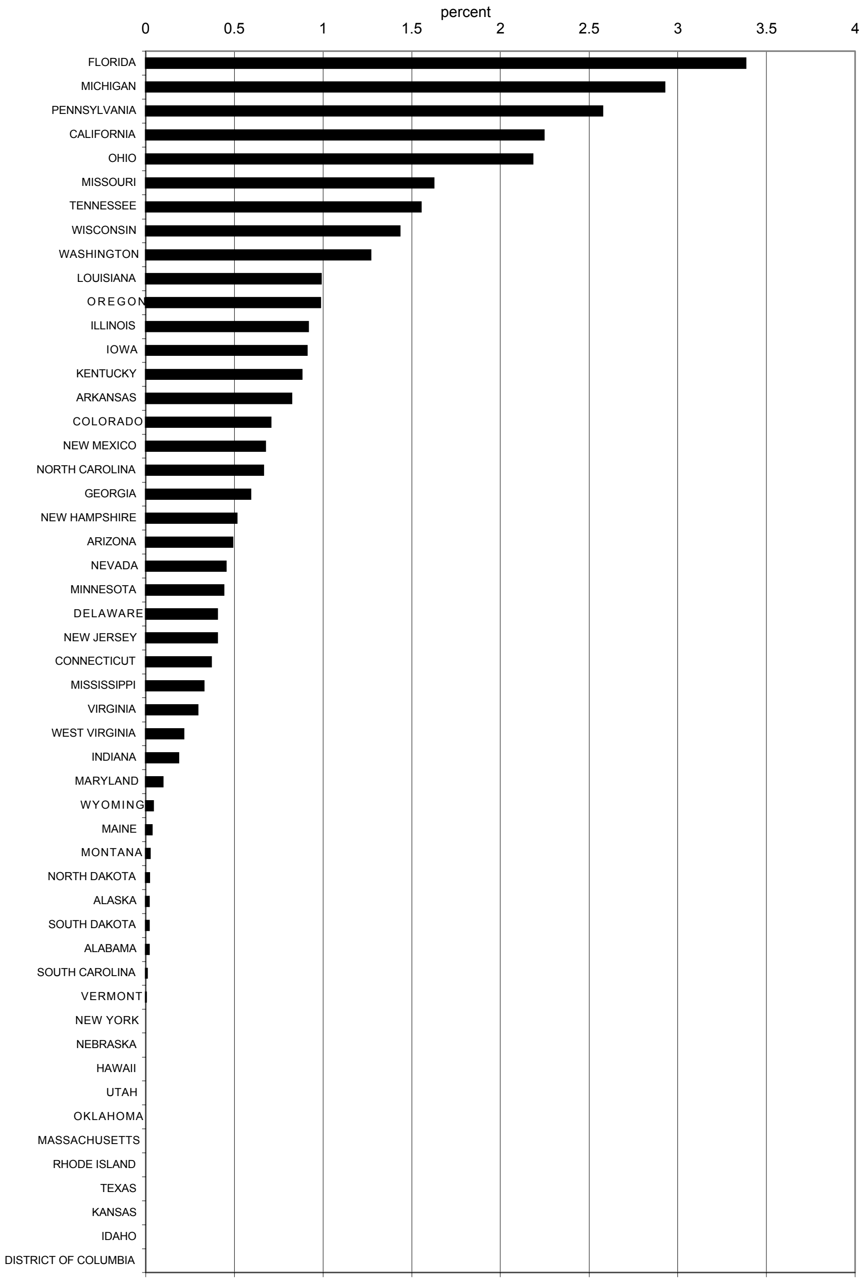

Figure 3.2: Joint probability of being pivotal and having state margin of victory less than 2 percent (based on September 2000 opinion polls)

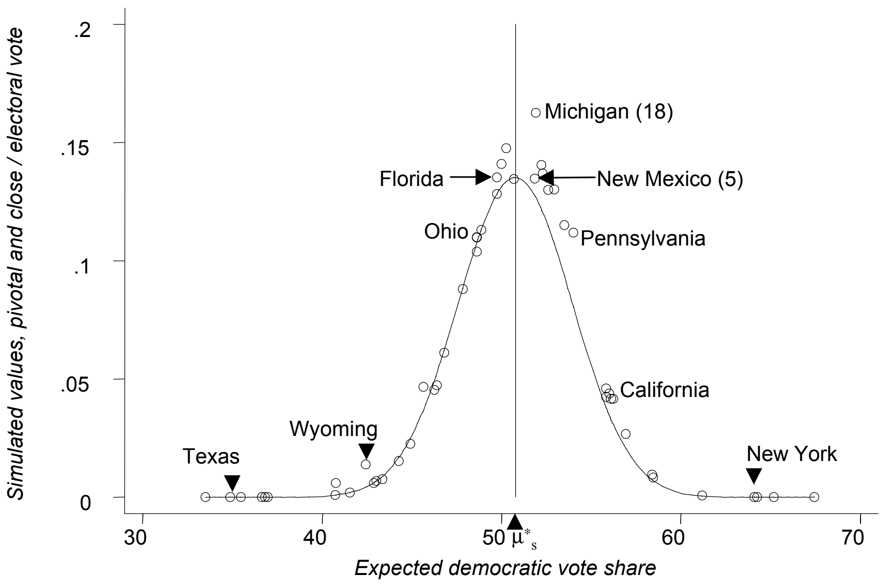

Figure 3.3: Pivotal and close per electoral vote

of 2000, Gore was ahead by 1.3 percentage points. The maximum Q_s/EV_s was obtained for states where the expected outcome was a democratic vote share of 50.8 percent, as illustrated in Figure (3.3). [2]

A second feature of Figure (3.3) is that there is some spread around the peak of this distribution. This spread arises because the candidates also have incentives to influence the variance of the electoral vote distribution. Candidates who are behind should try to increase variance in electoral votes. This is done by spending more time in states with many electoral votes, v_s, where this candidate is behind. Candidates who are ahead should try to decrease variance in electoral votes, thus securing their lead. This is done by spending more time in states with many

[2] The variance of the normal-form distribution,

$$\widetilde{\sigma}^2 = \frac{\frac{1}{(\sigma_E/a)^2} + \frac{1}{\sigma_s^2} + \frac{1}{\sigma^2}}{\frac{1}{\sigma^2\sigma_s^2} + \frac{1}{(\sigma_E/a)^2\sigma_s^2}},$$

depends on the variance in the state level popularity shocks. The reason Wyoming and two other states on the left of the distribution is above the normal-form curve is that state polls were not available for these states, and they are in fact on a separate normal form curve with higher variance.

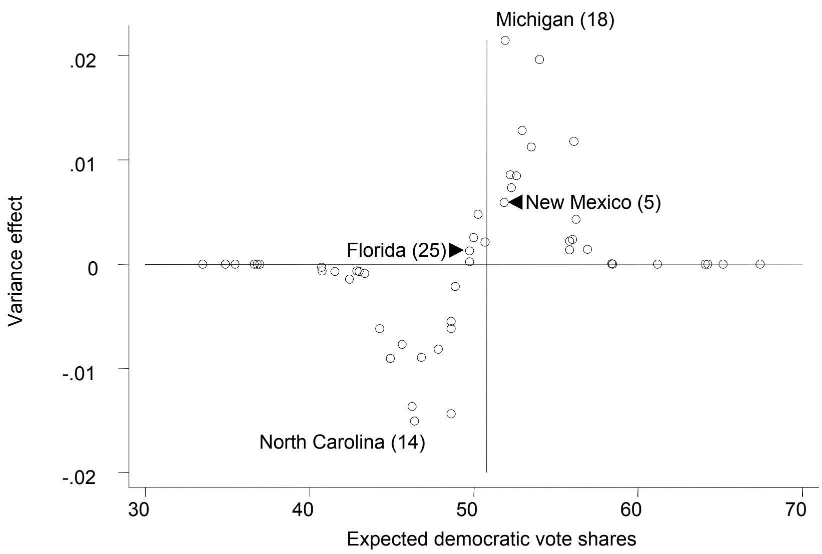

Figure 3.4: Incentive to influence variance

electoral votes, v_s, where this candidate is ahead. This leads both candidates to spend more time in large states where the expected winner is leading. This resounds the result by Snyder (1989) that parties will spend more in safe districts of the advantaged party than in save districts of disadvantaged party.

Figure (3.4) illustrates the effect of this term in the year 2000 election. Michigan benefits because it is a large state where the democrats were ahead in September. The expected outcome in New Mexico was about the same as in Michigan, but since New Mexico is smaller, the effect is smaller. The variance effect introduces a non-linear effect of electoral votes on Q_s. This is why Q_s is only roughly proportional to the number of electoral votes. On the opposite side, North Carolina should receive less attention since it is a large state where Bush was ahead.

3.1.2. Relation between Q_s and actual campaign visits

If one assumes log utility, then the optimal allocation, based on equation (2.4) is,

$$\frac{d_s^*}{\sum d_s^*} = \frac{Q_s}{\sum Q_s}, \tag{3.3}$$

and the number of days spent in each state should be proportional to Q_s.

The Bush and Gore campaigns were very similar to the optimal (using September opinion polls) campaign. The actual number of year 2000 campaign visits, after the party conventions, and Q_s, are shown in Figure (3.5).[3] Campaign visits by vice presidential candidates are coded as 0.5 visits. The model and the candidates' actual campaigns agree on 8 of the 10 states which should received most attention. Notable differences between theory and practice are found in Iowa, Illinois and Maine, which received more campaigning visits than predicted, and Colorado, which received less. Perhaps extra attention was devoted to Maine since its (and Nebraska's) electoral votes are split according to district vote outcomes. Other differences could be because the campaigns had access to information of later date than early September, and because aspects not dealt with in this paper matter for the allocation. The raw correlation between campaign visits and Q_s is 0.91. For Republican visits only the correlation is 0.90 and for Democratic visits, 0.88. A tougher comparison is that of campaign visits per electoral vote, d_s/EV_s, with Q_s per electoral vote, see Figure (3.6). The correlation between d_s/EV_s and Q_s/EV_s was 0.81 in 2000.

Next, I look at the 1996, 1992, and 1988 campaigns. For these campaigns, only presidential visits are available. The correlation between visits and Q_s during those years are: 0.85, 0.64, and 0.76 respectively. But this is mainly a result of presidential candidates spending more time in large states. For the 1996, 1992, and 1998 elections, the correlation between d_s/EV_s and Q_s/EV_s was 0.12, 0.58, and 0.25 respectively. An explanation for the poor fit in 1996 and 1988 may be that these elections were, ex ante, very uneven. The expected democratic vote shares in September of 1996, 1992, and 1988 were 56, 50, and 46 percent. In uneven races, candidates perhaps have other concerns than maximizing the probability of winning the election. It is also more difficult to figure out which states to give priority in uneven elections.

3.1.3. Estimating the effect of campaign visits on election outcomes

To complete the description of optimal strategies, the decreasing marginal impact of campaign visits should be estimated. This has been relegated to this last section since the estimation is not fully consistent with theory, and because this estimation is rather imprecise. If Democrats and Republicans allocate campaign visits according to this theory, and have the same information, then $\Delta u_s = 0$, and no effects can be estimated. In reality they do not. Under the assumption that

[3] I am grateful to Daron Shaw for providing me with the campaign data.

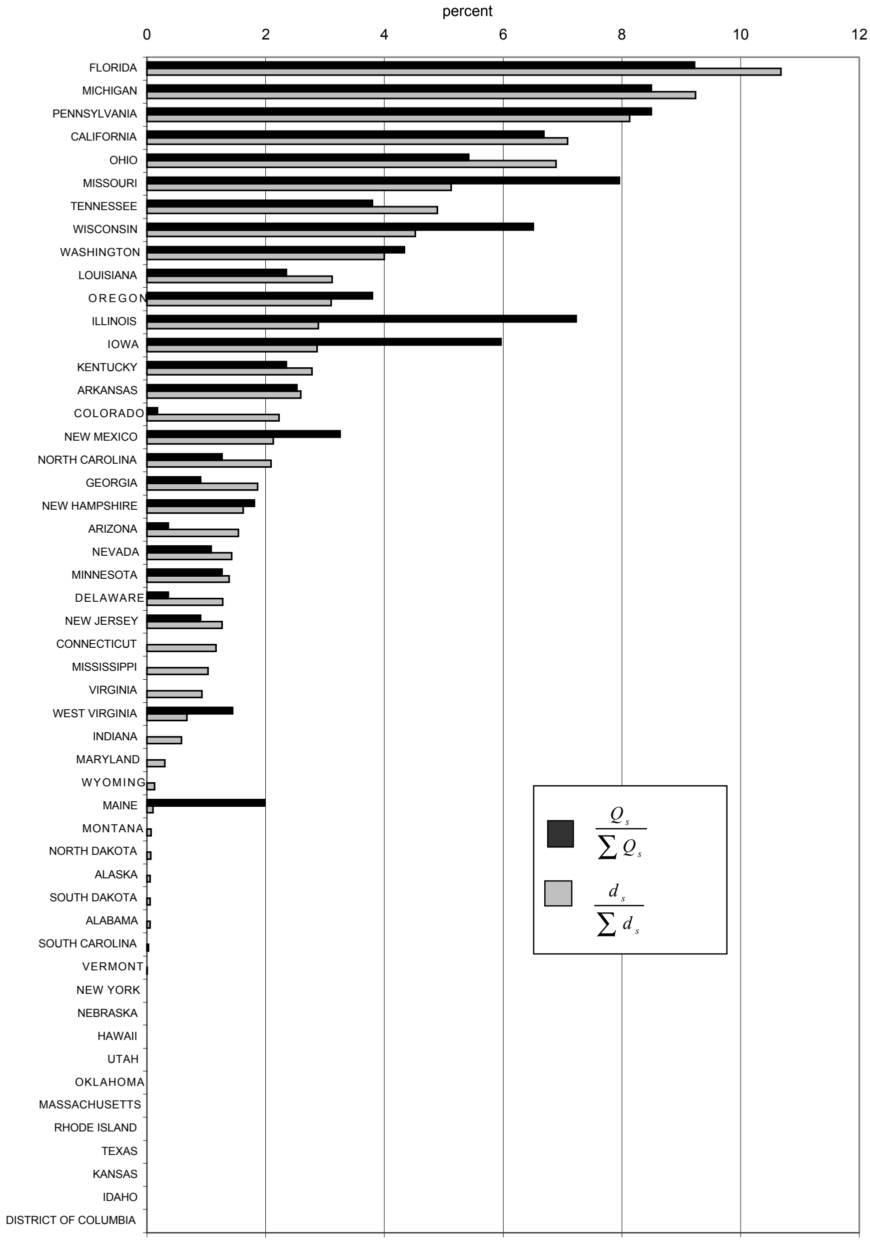

Figure 3.5: Actual and optimal (based on September forecasts) allocation of campaign visits

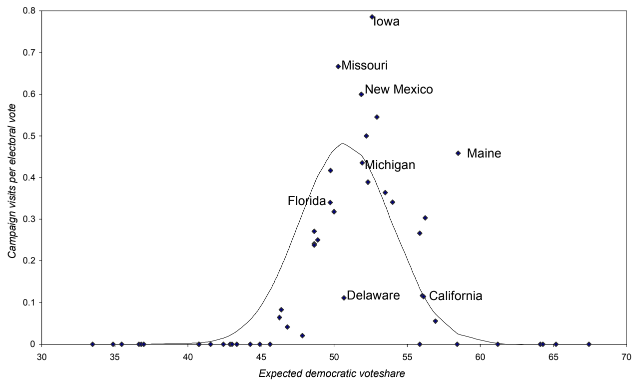

Figure 3.6: Campaign visits per electoral vote

Δu_s is not correlated with the popularity shocks, the effect of campaign visits may be estimated by including Δu_s in equation (3.2) and rearranging

$$\underbrace{\gamma_{st} - \widehat{\gamma}_{st}}_{\widehat{\varepsilon}_{st}} = \Delta u_s + \eta_{st} + \eta_t.$$

If one assumes the functional form

$$u_s\left(d_s\right) = \gamma d_s^{\alpha},$$

then the parameters γ and α determine the strength and decreasing marginal impact of campaign visits. Estimating

$$\widehat{\varepsilon}_{st} = \gamma\left(\left(d_{st}^{D}\right)^{\alpha} - \left(d_{st}^{R}\right)^{\alpha}\right) + \eta_{st} + \text{year effects}.$$

yields the parameter value, $\widehat{\alpha} = 0.65$, with standard error of 0.5. The estimate implies that if the Gore spent one and Bush no days in a state, then Gore would gain 0.4 percentage points; if Gore spent two and Bush one, then Gore would gain 0.2 percentage points; if Gore spent ten and Bush seven days in a state (as was the case in Florida), then Gore would gain 0.3 percentage points.[4] These effects are similar to those of Shaw (1999) who estimated the effect of one extra campaign

[4] A complication is that if $\Delta u_{st} \neq 0$, then the estimated equation (3.2) is incorrectly specified. However, including Δu_{st} and re-estimating this equation makes little difference as the correlation between Q_s/EV estimated with and without Δu_{st} is 0.996.

day to 0.8 extra points in the opinion poll, which, according to the estimates in this paper, corresponds to an increase in of 0.36 percentage points in the election.

In this specification, the equilibrium allocation is

$$\frac{d_s^*}{\sum d_s^*} = \frac{Q_s^{\frac{1}{1-\alpha}}}{\sum Q_s^{\frac{1}{1-\alpha}}}. \tag{3.4}$$

This allocation is shown in Figure (3.7). The estimated α implies that the marginal impact of an additional campaign visit declines slower than the earlier logarithmic utility specification. Therefore incentives are sharper and visits are less equally distributed.

3.2. Federal civilian employment 1948-1996

Although it is important for the political system, the direct effect of campaign spending on people's welfare is limited. This section explores whether the electoral college system also affected federal civilian employment. This application was chosen since the Executive may potentially influence federal employment. Although Congress is directly involved in decisions about the construction of federal facilities, most decisions about the geographic allocation of federal employment are made by administrative agencies (Arnold, 1979). Further, there is some evidence that Congress members have not been able to influence employment, for example, Arnold (1979) found no support for the hypothesis that members of military committees were able to affect military employment in their districts 1952-1974.

In 1996, the Federal government employed 2.7 million civilian workers, which is around 2 percent of the US work force.. These workers' main employer is the executive branch, the legislative branch employs only about one percent of Federal workers, nearly all of whom work in the Washington D.C. area.[5] The employees contain a high proportion of professionals and technicians. The largest cabinet department employer is Defense, employing around 50% of these workers in 1952 and 30% in 1999. These civilian workers perform various support activities, such as payroll and public relations. Other large employers are the cabinet department of Veteran Affairs, the Treasury, Agriculture, Justice and Interior.

Suppose an incumbent president wishes to allocate federal civilian employment across states in order to maximize his re-election probabilities. The model will be slightly modified to analyze this problem. Let z_s be federal civilian employment

[5] Therefore Washington D.C. will be excluded from the empirical analysis.

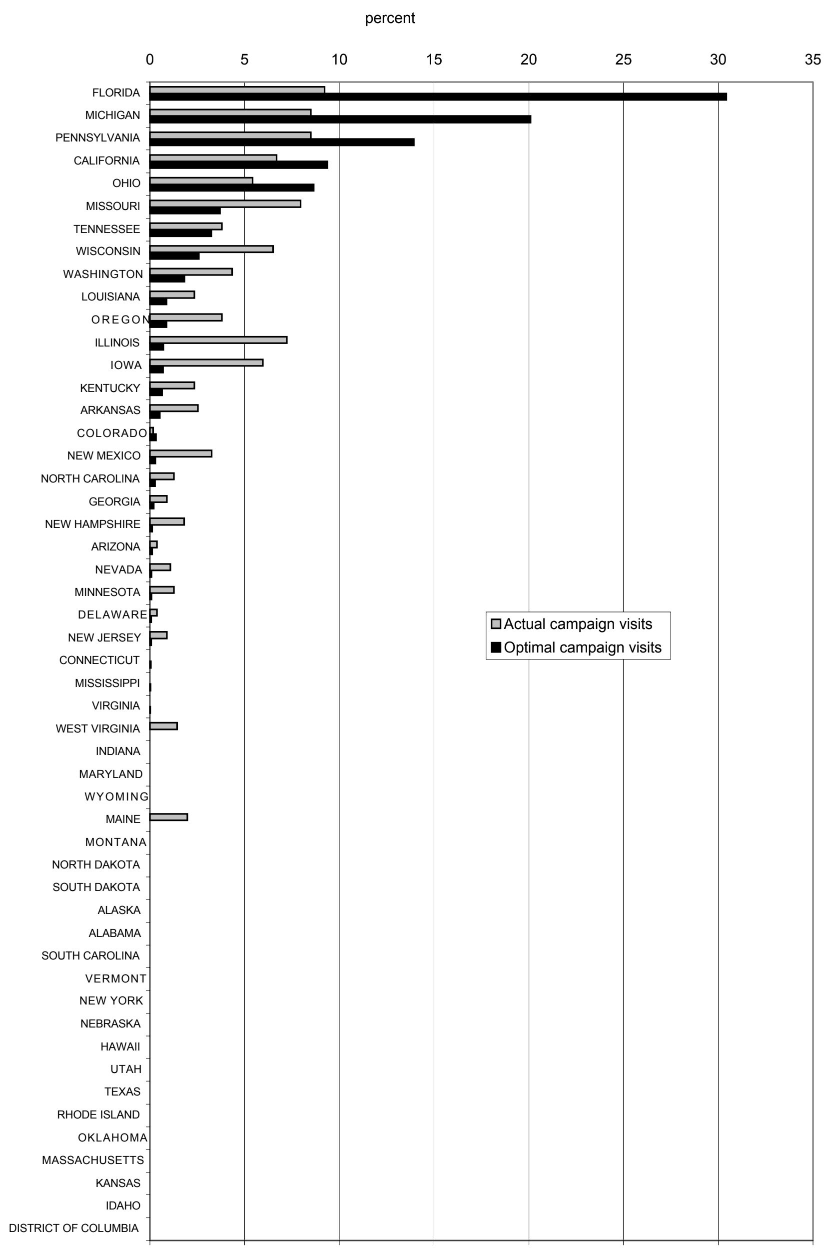

Figure 3.7: Equilibrium allocation, $\alpha = 0.65$

per capita. Suppose each voter i in state s follows the voting rule to vote for the (Democratic) incumbent if

$$\Delta u_s = u_s\left(z_s^D\right) - u_s\left(z_s^*\right) \geq R_i + \eta_s + \eta.$$

This replaces equation (2.1). The voters punish the incumbent president for allocating less resources to their state than they expect from an average incumbent (equilibrium spending). Given this voting rule, allocation which maximizes the probability of winning the election is characterized by equation (2.4) and the budget constraint. An incumbent should allocate more resources to states which are likely to be pivotal and at the same time have close elections, that is with high Q_s.

A difference is that the decision of how to allocate federal employment must be taken well before the election. I assume that the incumbent bases his estimate of Q_s on information available one year before the election. The variables in X_s are the same as before, except that opinion polls are excluded, and that state ADA-scores from two years before the election are used. The estimated standard deviation of the state-level popularity-shock is now $\sigma_s = 0.13$, while the national popularity shock has a standard deviation of $\sigma = 0.10$. So the uncertainty, both at state and national level, is now considerably larger.

Making the assumption that preferences are described by

$$u_s\left(z_s\right) = k - \gamma z_s^{-\alpha},$$

equilibrium spending equation (2.4) may be reformulated as

$$ln\left(z_s\right) = \frac{1}{1+\alpha} ln\left(\frac{Q_s}{n_s}\right).$$

Table 2 shows the results from a regression using the above specification. State fixed-effects and year fixed-effects are included in all regressions. Column I contains the basic specification. The positive coefficient on Q_s per capita shows that when a state is more important for electoral concerns than average, then federal civilian employment is also significantly higher than average in that state. Column II controls for income per capita and total employment per capita. Columns III-IV tests dynamic specifications by controlling for lagged civilian employment. Q_s per capita is significantly correlated with federal civilian employment per capita in all specifications.[6]

[6] The coefficients in the dynamic specifications are biased. The same regressions were run using the estimator suggested by Arrelano and Bond (1991). The coefficient on Q_s per capita and z_s is slightly larger and slightly more significant using this estimator.

These results suggest that the electoral college system has affected federal employment decisions. The correlations show that federal employment increased in states whose importance for presidential election outcomes increased. The estimate implies that increasing Q_s per capita by one standard deviation increases federal civilian employment per capita by 2 percent. A change from minimum to maximum in Q_s per capita increases federal civilian employment per capita by 19 percent.

3.3. Government spending in the 1930s

This third application concerns a major New Deal program for providing unemployment relief. This program is suitable for analysis since it is likely that the president could influence the allocation across states. President Roosevelt appointed the federal administrator, Harry Hopkins, responsible for allocating funds across states. During the implementation of the program Hopkins was criticized by Roosevelt's political adversaries for allocating money with political motives.

The vote share equation is now more parsimonious than the earlier specifications. X_{st} only includes incumbency and home state variables. The average state election error is 7.6 percent, and the wrong winner is predicted in 20 percent of state elections. National shocks and the state level shocks are of about equal size: $\sigma_s = 0.18$, $\sigma = 0.22$. The distribution of Q_s in 1936 are shown in Figure (3.8). The situation was quite different from the 2000 election. New York was then the state most likely to be pivotal in the Electoral College at the same time as it had a close election.

In Figure (3.9), per capita relief expenditures have been plotted against Q_s/EV_s. As is evident from the graph, there is a strong positive correlation, in fact, 0.5.

The above hypotheses are tested by regressing per capita relief spending to states against Q_s/n_s. The unemployment relief program was intended to provide relief to poor and unemployed. Unemployment in 1930 and 1937, per capita income, and bank deposits per capita, population size and population density are included as control variables. The results are shown in Table 3. Q_s/n_s is significantly correlated with per capita relief spending at the five percent level. These results are consistent with the hypothesis that presidential electoral concerns affected the allocation of relief spending.

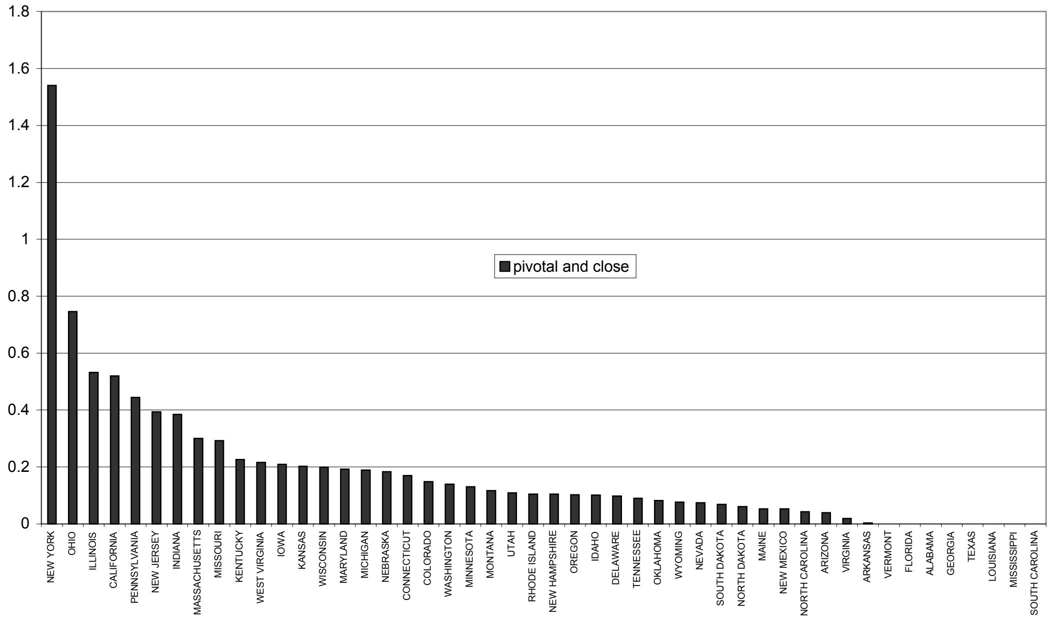

Figure 3.8:

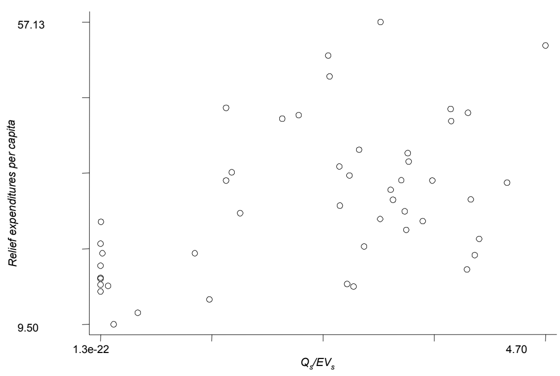

Figure 3.9:

4. Direct national presidential vote

The potential effects of an institutional reform are now investigated. Suppose the president was elected by a direct national vote. The number of Democratic votes in state s would then equal

$$n_s F_s(\Delta u_s - \eta - \eta_s).$$

The Democratic candidate wins the election if

$$\sum_s n_s F_s(\Delta u_s - \eta - \eta_s) \geq \frac{1}{2} \sum_s n_s.$$

The number of votes won by candidate D is asymptotically normally distributed with mean and variance

$$\begin{aligned} \mu_v &= \sum_s n_s \Phi\left(\frac{\Delta u_s - \mu_s - \eta}{\sqrt{\sigma_s^2 + \sigma_{fs}^2}}\right), \\ \sigma_v^2 &= \sigma_v^2\left(\Delta u_s, \eta\right). \end{aligned} \tag{4.1}$$

See appendix for the explicit expression for σ_v^2. The probability of a Democratic victory is

$$P^D = \int \Phi\left(\frac{\mu_v - \frac{1}{2}\sum_s n_s}{\sigma_v}\right) d\eta.$$

Both candidates again choose election platform subject to the budget constraint. Given that the concavity conditions are satisfied, the following proposition characterizes the equilibrium allocation.

Proposition 4.1. *A pair of strategies for the parties* $\left(d^D, d^R\right)$ *that constitute a NE in the game of maximizing the expected probability of winning the election must satisfy* $d^D = d^R = d^*$, *and for all* s *and for some* $\lambda > 0$

$$Q_{sv} u_s'\left(d_s\right) = \lambda. \tag{4.2}$$

The variable Q_{sv} measures the marginal voter density, $f_s(\cdot)$, evaluated at combinations of national shock and state level shocks which would cause a draw, weighted by the likelihood of these shocks.[7] This marginal voter density depends crucially on the estimated variance in the preference distribution, σ_{fs}^2.

[7] However, the analytic expression for Q_{sv} is complicated, see appendix. The correlation between Q_{sv} and the marginal voter density, evaluated at the national shock which would cause an expected draw is 0.999.

In order to correctly predict allocation under direct vote, σ_{fs}^2 will be allowed to vary across states. Therefore, the restriction $\sigma_{fs}^2 = 1$ is removed in the maximum likelihood estimation of equation (3.1). The parameters σ_{fs}^2 are empirically identified by the covariation between vote outcomes and economic growth at national and state level, incumbency variables, home state of the president and vice president, and dummy variables. States were the vote outcome covary strongly with economic growth, etc., are thus estimated to have many marginal voters. This estimated marginal voter density is negatively correlated with state size. In other words, vote outcomes in larger states respond less to economic and other shocks. It is not strongly correlated with vote shares.

4.1. Welfare

I will study the welfare effects of the allocation of federal civilian employment. Suppose that a social planner maximizes the unweighted sum of utilities:

$$\max_z W = \sum_i n_s u_s (z_s),$$

subject to the resource constraint

$$\sum_s n_s z_s = I.$$

In the social optimum, marginal utilities are equalized across states:

$$u_s' (z_s) = \lambda.$$

Compare this with the political allocation under the electoral college and direct vote:

$$\begin{aligned} u_s' (z_s) &= \lambda / \frac{Q_s}{n_s} \\ u_s' (z_s) &= \lambda / \frac{Q_{sv}}{n_s}. \end{aligned}$$

The political incentives drive a wedge between the marginal utilities in different states. If $\frac{Q_s}{n_s}$ and $\frac{Q_{sv}}{n_s}$ vary a lot across states, then the political incentives will induce variation in per capita resource allocation level which is undesirable from a societal point of view.

Whether this politically induced variation will be higher under the electoral college system or under direct vote is a priori unclear. The mean of the direct vote distribution, equation (2.3), is less sensitive to changes in Δu_s than the mean of the electoral vote distribution, equation (4.1). This leads to a more equal distribution of Q_{sv} relative to Q_s. On the other hand, heterogeneity in σ_{fs}^2 introduces variation in Q_{sv} but not in Q_s. Which distribution is more equal in the end is an empirical question. Also, since the distributions of Q_{sv} an Q_s depend on the degree of uncertainty, their distributions will be different for the different applications.

Equilibrium spending under the electoral college, equation (2.4), may be reformulated as

$$z_s = \alpha_s \frac{I}{N},$$

where

$$\alpha_s = \frac{\left(\frac{Q_s}{n_s}\right)^{\frac{1}{1+\alpha}}}{\frac{1}{N}\sum n_s \left(\frac{Q_s}{n_s}\right)^{\frac{1}{1+\alpha}}}.$$

The value of α_s shows how much spending state s receives relative to the socially optimal allocation. States who are favored by the electoral college system thus have α_s which are larger than one. The equilibrium allocation under the direct vote is

$$z_{sv} = \alpha_{sv} \frac{I}{N},$$

where α_{sv} is obtained by exchanging Q_{sv} for Q_s in the expression for α_s above.

The values of α_s and α_{sv} are calculated for each state for the years 1948-1996. Figure (4.1) shows a histogram of the frequencies of values of α_s and α_{sv}, where the latter is clearly more concentrated around one. It is possible to identify states who should, on average, have benefited from the electoral college system. Figure (4.2) shows the average α_s and α_{sv} during the period 1948-1996. States such as Delaware, Montana, Vermont and Nevada have benefited from the electoral college system as they have average α_s larger than one. States who should, on average, have lost are Nebraska, Massachussetts, Rhode Island and Georgia.

Political incentives distorts employment allocation less under direct vote than under the electoral college system. One way to show this is to show that the Lorentz curves for federal employment under direct vote is strictly above that of spending under electoral college, see Figure (4.3). Thus any strictly quasi-concave social welfare function would strictly prefer allocation under direct vote to allocation under electoral college.

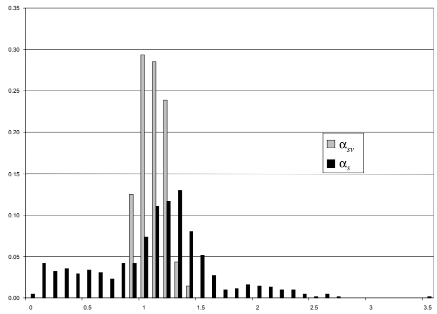

Figure 4.1: Frequency histograms for α_s and α_{sv}.

5. Conclusions

This paper shows that presidential candidates should allocate more resources to states with a high joint probability of being pivotal in the electoral college and having a close state election. This probability is then characterized, theoretically and empirically. Next, empirical evidence was presented suggesting that presidential candidates and incumbents take these considerations into account when allocating both campaign resources and federal employment across states. Finally, it is found that the resource allocation would be less distorted under direct vote than under the present electoral college system.

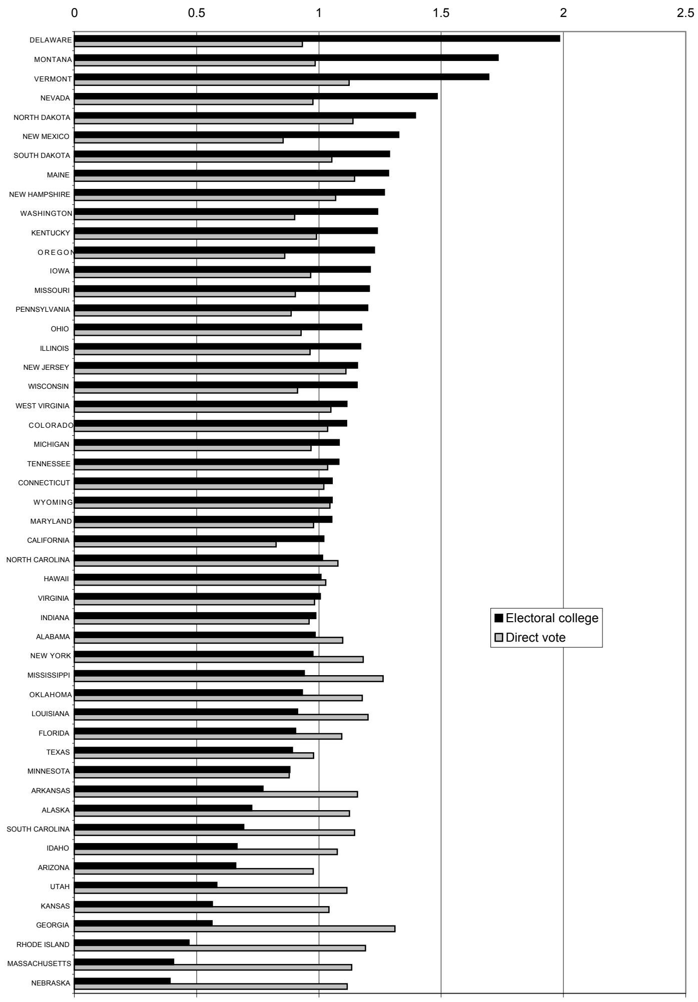

Figure 4.2: Average predicted political bias in allocation of federal civilian employment

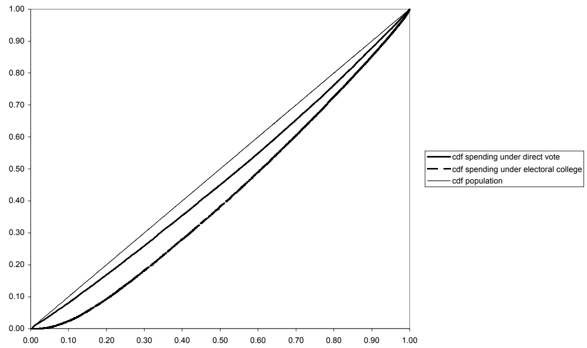

Figure 4.3: Lorentz curves for spending under electoral college and direct vote

References

[1] Brams, Steven J. and Morton D. Davis, "The 3/2 Rule in Presidential Campaigning." American Political Science Review, March 1974, 68(1), 113-34.

[2] Campbell, J. E. (1992). Forecasting the presidential vote in the states. American Journal of Political Science, 36, 386-407.

[3] Cohen, Jeffrey E., "State-level public opinion polls as predictors of Presidential Election Results", American Politics Quarterly, Apr98, Vol. 26 Issue 2, 139.

[4] Gelman, Andrew, and Jonathan N. Katz, "How much does a vote count? Voting power, coalitions, and the Electoral College", Social Science Working Paper 1121, 2001, California Institute of Technology.

[5] Lindbeck, A., Jörgen W. Weibull, "Balanced-budget redistribution as the outcome of political competition", Public Choice, 1987, 52, 273-97.

[6] Persson, Torsten, and Guido Tabellini, "Political Economics: explaining economic policy", MIT Press, 2000.

[7] Shaw, Daron R., "The Effect of TV Ads and Candidate Appearances on Statewide Presidential Votes, 1988-96, American Political Science Review 93(2), 1999, 345-361.

[8] Snyder, James M., "Election Goals and the Allocation of Campaign Resources", Econometrica 57(3), 1989, 637-660.

6. Appendix

6.1. Derivation of Q_s

$$Q_s = \frac{\partial}{\partial \Delta u_s} \int 1 - \Phi\left(\frac{\frac{1}{2}\sum_s v_s - \mu}{\sigma_E}\right) h(\eta)\, d\eta =$$

where

$$\begin{aligned} \mu &= \mu\left(z^D, z^R, \eta\right) = \sum_s v_s G_s\left(\Delta u_s - \mu_s - \eta\right) \\ \sigma_E^2 &= \sigma^2\left(z^D, z^R, \eta\right) = \sum_s v_s^2 G_s(\cdot)\left(1 - G_s(\cdot)\right). \end{aligned}$$

$$\begin{aligned} Q_s &= Q_{s\mu} + Q_{s\sigma} \\ &= v_s \int \frac{1}{\sigma_E}\varphi\left(\frac{\frac{1}{2}\sum_s v_s - \mu}{\sigma_E}\right) g_s\left(-\mu_s - \eta\right) h(\eta)\, d\eta \\ &\quad + v_s \int \frac{1}{\sigma_E}\varphi\left(\frac{\frac{1}{2}\sum_s v_s - \mu}{\sigma_E}\right) g_s\left(-\mu_s - \eta\right) h(\eta)\, 2\frac{v_s}{\sigma_E}\left(\frac{\frac{1}{2}\sum_s v_s - \mu}{\sigma_E}\right)\left(G_s(.) - \frac{1}{2}\right) d\eta \end{aligned}$$

The first term is effect of changing the mean of the distribution, the second the effect of changing the variance. To simplify, do a first order Taylor expansion of the mean of the expected number of electoral votes $\mu(\eta)$ around $\eta = \widetilde{\eta}$ for which $\mu(\widetilde{\eta}) = \frac{1}{2}\sum_s v_s$, that is the value of the national shock which makes a draw most likely. With this approximation

$$\mu(\eta) = \sum_s v_s G_s\left(-\mu_s - \eta\right) \approx \frac{1}{2}\sum_s v_s - a\left(\eta - \widetilde{\eta}\right),$$

$$a = \sum_s v_s g_s\left(-\mu_s - \widetilde{\eta}\right).$$

Then

$$\varphi\left(\frac{\frac{1}{2}\sum_s v_s - \mu}{\sigma}\right) \approx \varphi\left(\frac{\eta - \widetilde{\eta}}{\sigma / a}\right).$$

Further, the mean of the electoral votes, $\mu(\eta)$, is much more sensitive to national shocks than is the variance $\sigma_E(\eta)$. Therefore σ_E is assumed fixed

$$\sigma_E(\eta) = \sigma_E(\widetilde{\eta}) = \sum_s v_s^2 G_s\left(-\mu_s - \widetilde{\eta}\right)\left(1 - G_s\left(-\mu_s - \widetilde{\eta}\right)\right).$$

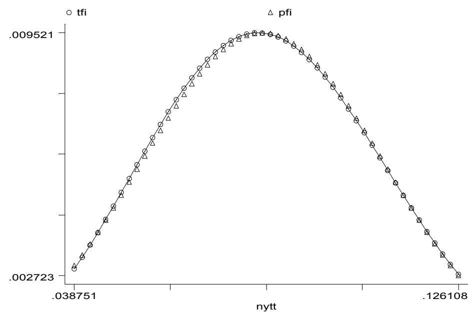

Figure 6.1:

Then

$$\frac{1}{\sigma_E(\eta)}\varphi\left(\frac{\frac{1}{2}\sum_s v_s-\mu}{\sigma_E(\eta)}\right)\approx\frac{1}{\sigma_E(\widetilde{\eta})}\varphi\left(\frac{\eta-\widetilde{\eta}}{\sigma_E(\widetilde{\eta})/a}\right)$$

Simulations show that the approximation is very good. The graph below shows the true, tfi, and the approximated functions, pfi. The values are calculated for an interval of four standard deviations centered around the calculated $\widetilde{\eta}=.08$ in the 1976 presidential election. (program cprob2) We now have

$$Q_{s\mu}\approx v_s\frac{1}{\sigma_E(\widetilde{\eta})}\int\varphi\left(\frac{\eta-\widetilde{\eta}}{\sigma_E(\widetilde{\eta})/a}\right)g_s(-\mu_s-\eta)\,h(\eta)\,d\eta.$$

Integrating over η,

$$Q_{s\mu}\approx v_s\frac{\omega}{2\pi}\exp\left(-\frac{1}{2}\frac{\sigma_s^2\widetilde{\eta}^2+(\sigma_E/a)^2\mu_s^2+\sigma^2(\widetilde{\eta}+\mu_s)^2}{\sigma_s^2\sigma^2+(\sigma_E/a)^2\sigma^2+(\sigma_E/a)^2\sigma_s^2}\right)$$

where

$$\omega^2=\left(\frac{1}{(\sigma_E/a)^2}+\frac{1}{\sigma_s^2}+\frac{1}{\sigma^2}\right)^{-1}.$$

$Q_{s\mu}$ may be written as

$$Q_{s\mu}\approx v_s\frac{\omega}{2\pi}\exp\left(-\frac{1}{2}\frac{c+(\mu_s-\mu_s^*)^2}{\widetilde{\sigma}^2}\right),$$

where

$$\mu_s^*=-\frac{\sigma^2}{\sigma^2+(\sigma_E/a)^2}\widetilde{\eta},$$

and

$$\widetilde{\sigma}^2 = \frac{\frac{1}{(\sigma_E/a)^2} + \frac{1}{\sigma_s^2} + \frac{1}{\sigma^2}}{\left(\frac{1}{\sigma^2\sigma_s^2} + \frac{1}{(\sigma_E/a)^2\sigma_s^2}\right)}.$$

$Q_{s\sigma}$ is calculated using numerical integration.

6.2. Direct presidential vote

The mean outcome in state s is

$$\mu_{vs}\left(z^L, z^R, \eta\right) = \int F_s(\Delta u_s - \eta - \eta_s) g_s\left(\eta_s\right) d\eta_s$$

$$= \int_{-\infty}^{\infty}\int_{-\infty}^{0} \frac{1}{\sqrt{2\pi\sigma_{fs}^2}} \exp\left(-\frac{1}{2}\frac{\left(x + \Delta u_s - \eta - \mu_s - \eta_s\right)^2}{\sigma_{fs}^2}\right) dx g_s\left(\eta_s\right) d\eta_s$$

$$= \Phi\left(\frac{\Delta u_s - \eta - \mu_s}{\sqrt{\sigma_s^2 + \sigma_{fs}^2}}\right).^8$$

The expression for the variance is, by definition,

$$\sigma_{vs}^2 = n_s^2 \int \left(\Phi\left(\frac{\Delta u_s - \eta - \eta_s - \mu_s}{\sigma_{fs}}\right) - \Phi\left(\frac{\Delta u_s - \eta - \mu_s}{\sqrt{\sigma_s^2 + \sigma_{fs}^2}}\right)\right)^2 g_s\left(\eta_s\right) d\eta_s.$$

The probability of D winning the election is

$$P^D\left(z^D, z^R\right) = \int \Phi\left(\frac{\mu_v - \frac{1}{2}\sum_s n_s}{\sigma_v}\right) d\eta.$$

The derivative of $P^D\left(z^D, z^R\right)$ with respect to Δu_s equals

$$Q_{sv} = \int \frac{1}{\sigma_v^2}\varphi\left(\frac{\mu_v - \frac{1}{2}\sum_s n_s}{\sigma_v}\right)\left(\frac{\partial\mu_v}{\partial\Delta u_s} - \frac{\mu_v - \frac{1}{2}\sum_s n_s}{\sigma_v}\frac{\partial\sigma_v}{\partial\Delta u_s}\right) h\left(\eta\right) d\eta = Q_{s\mu} + Q_{s\sigma}.$$

Using this information, $Q_{s\mu}$ may be calculated either using the approximation as earlier, or by numerical integration. The second term, $Q_{s\sigma}$, may be calculated by numerical integration. However, it turns out that this effect is negligible compared to $Q_{s\mu}$.

[8] This is not a completely trivial calculation. Contact the author for details.

7. Data definitions and sources

- Dmvote: state democratic percentage of the two-party presidential vote. Source: 1940-1944, ICPSR Study 0019; 1948-1988, Campbell; 1992, 1996, Statistical Abstract of the United States 2000; 2000, Federal Election Commission, 2000 OFFICIAL PRESIDENTIAL GENERAL ELECTION RESULTS.

- Electoral votes won (by state). Source: National Archives and Records Administration.

- National trial-heat poll results. Source: 1948-1996, Campbell (2000); 2000, Gallup.

- Second quarter national economic growth, multiplied by 1 if democratic incumbent president and -1 if republican incumbent president. Source: August or September election year issue of the Survey of Current Business, U.S. Department of Commerce, Bureau of Economic Analysis.

- Growth in personal state's total personal income between the prior year's fourth quarter and the first quarter of the election year, standardized across states in each year, multiplied by 1 if democratic incumbent president and -1 if republican incumbent president. Source: Survey of Current Business, U.S. Department of Commerce, Bureau of Economic Analysis.

- Incumbent: 1 if incumbent president democrat, -1 if incumbent president republican.

- Presinc: 1 if incumbent democratic president seeking re-election, -1 if incumbent republican president seeking re-election.

- President's home state: 1 if democratic president home state, -1 if republican (0.5 and -0.5 for large states (New York, Illinois, California). Source: Campbell 1948-1988; 1992-2000: Dave Leip's Atlas of U.S. Presidential Elections.

- Vice president's home state: 1 if democratic president home state, -1 if republican (0.5 and -0.5 for large states (New York, Illinois, California). Source: Campbell 1948-1988; 1992-2000: Dave Leip's Atlas of U.S. Presidential Elections.

- Average ADA-scores: Average ADA-scores of state's members in Congress year before election. Source: Tim Groseclose (http://faculty-gsb.stanford.edu/groseclose/homepage.htm).

- Legis: Partisan division of the lower chamber of the state legislature after the previous midterm election. Index is Democratic share of state legislative seats above the 50% mark. Two states, Nebraska and Minnesota, held nonpartisan state legislative elections for all (Nebraska) or part (Minnesota of the period under study. In the case of Nebraska, the state legislative division was estimated based on the ranking of states of Wright, Erikson, and McIver's state partisan rankings based on public opinion data. Using this index, Nebraska was assigned the mean partisan division of the state most similar to it on the public opinion index, the nearly equally republican state of North Dakota. The partisan division of the Minnesota legislature in its nonpartisan years (before 1972) is coded as the mean of its partisan division once it reformed to partisan elections (62% Democratic). Washington D.C. was as having the same partisan division as Maryland. Source: 1948-1988, Campbell; 1992-2000, Statistical Abstract of the United States.

- State-level opinion polls. Democratic share of two party vote. Source: Pre-election issues of the Hotline (www.nationaljournal.com).

- Regional dummy variables, see Campbell.

- Federal civilian employment. Source: Statistical Abstract of the United States.

- Total employment: Total non-farm employees, not seasonally adjusted, January. Source: Bureau of Labor Statistics.

- Income per capita: Per capita personal income. Source: Bureau of Economic Analysis.

- FERA spending/capita: Cumulative disbursement within the FERA program April 1933 to December 1935/(0.6*population size 1930 + 0.4*population size 1940). Source *Work Projects Administration, Final Statistical Report of the Federal Emergency Relief Administration*, Washington: US. Government Printing Office, 1942.

- Unemployment in 1930: total number of persons out of a job, able to work, and looking for a job 1930/population 1930. Source: *Historical, Demographic, Economic, and Social Data: The United States, 1790-1970* [Computer file]. Ann Arbor, MI: Inter-university Consortium for Political and Social Research.

- Unempl. 1937: number of totally unemployed persons registered 1937/(0.3*population 1930+0.7*population 1940). Source: *Historical, Demographic, Economic, and Social Data: The United States, 1790-1970* [Computer file]. Ann Arbor, MI: Inter-university Consortium for Political and Social Research.

- Income 1934: Per capita personal income (dollars). Source: Bureau of Economic Analysis. Regional Accounts Data. State Annual Personal Income. Series SA05. Line 30.

- Bank deposits/capita: bank deposits 1934/(0.6*population size 1930 + 0.4*population size 1940). Source: *Federal Deposit Insurance Corporation Data on Banks in the United States, 1920-1936* [Computer file]. ICPSR ed. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [producer and distributor], 196?.;

- Population (1934): 0.6*population 1930 + 0.4*population 1940. Source: *Historical, Demographic, Economic, and Social Data: The United States, 1790-1970* [Computer file]. Ann Arbor, MI: Inter-university Consortium for Political and Social Research.

- Pop. density: population per square mile 1930. Source: *Historical, Demographic, Economic, and Social Data: The United States, 1790-1970* [Computer file]. Ann Arbor, MI: Inter-university Consortium for Political and Social Research.

Table 1. Dependent variable: γ_{st} , Φ^{-1}(*democratic share of two-party vote*)

National variables:	
Opinion poll,	0.453 (0.052)
Second quarter economic growth	0.064 (0.010)
Incumbent president running for re-election	0.052 (0.022)
Incumbency	-0.036 (0.017)
Constant	-0.049 (0.010)
State variables, 1948-1984	
Lagged democratic share of two-party vote, difference from national mean	0.274 (0.036)
Twice lagged democratic share of two-party vote, difference from national mean	0.205 (0.036)
Home state of presidential candidate	0.184 (0.029)
Home state of vice presidential candidate	0.064 (0.023)
Lagged home state of presidential candidate	-0.004 (0.028)
Lagged home state of vice presidential candidate	-0.032 (0.026)
First quarter state economic growth.	0.017 (0.005)
Average ADA-scores	0.0021 (0.0003)
Democratic vote-share in midterm state legislative election	0.023 (0.008)
State variables, 1988-2000	
Lagged democratic share of two-party vote, difference from national mean	0.515 (0.081)
Twice lagged democratic share of two-party vote, difference from national mean	0.074 (0.070)
Average ADA-scores	0.0009 (0.0004)
State-level opinion poll	0.389 (0.050)
σ	0.032 (0.007)
$\sigma_{s1948\text{-}1984}$	0.102 (0.003)
$\sigma_{s1948\text{-}1984}$ - $\sigma_{s1988\text{-}2000}$	0.024 (0.005)
Average prediction error (percentage points)	3.0
Number of observations	672

Table 2. Dependent variable: *log federal civilian employment per capita*

	I	II	III	IV
lagged dependent variable			0.50	0.46
			(0.04)	(0.04)
Q_s per capita	0.86	0.51	0.57	0.43
	(0.22)	(0.22)	(0.20)	(0.20)
income per capita		0.59		0.31
		(0.15)		(0.14)
employment per capita		0.18		0.04
		(0.13)		(0.12)
state effects	yes	yes	yes	yes
year effects	yes	yes	yes	yes
number of observations	574	573	574	573

Standard errors in parenthesis. All variables are in logs.

Table 3. Dependent variable: *log relief spending per capita*

	I
Q_s per capita	0.048
	(0.020)
unemployment 1937	0.43
	(0.27)
unemployment 1930	0.28
	(0.39)
income per capita	0.02
	(0.39)
bank deposits per capita	0.06
	(0.19)
population	0.08
	(0.06)
population density	-0.13
	(0.05)
constant	6.08
	(3.61)
number of observations	46

Standard errors in parenthesis. All variables are in logs.