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Economic Performance, Voting, and Political Support: A Unified Approach

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ECONOMIC PERFORMANCE, VOTING, AND POLITICAL SUPPORT: A UNIFIED APPROACH

Henry W. Chappell, Jr.*

Abstract—A presidential vote function and a presidential approval ratings function are jointly estimated for U.S. post-war observations. The estimation technique treats the two equations as seemingly unrelated regressions with unequal numbers of observations. Cross-equation restrictions implying that voters and poll respondents use identical standards in judging the economic performance of incumbents are imposed and tested. Estimates show that both votes and approval ratings are influenced by GNP growth and inflation. The results suggest that poll respondents are more inflation averse than voters; however, tests of this hypothesis are not conclusive.

THERE is agreement that macroeconomic issues "matter" for political evaluations, but how they matter is not fully understood. Differing theoretical perspectives underlie some disagreements, and inherent data limitations have provided further obstacles to consensus. This paper focuses on issues related to data limitations and adopts a method for efficiently using data which are available.

By empirically linking the time series for an incumbent party's vote share to key economic indicators, one can gain information about how voters evaluate economic performance. In well-known studies, Kramer (1971) and Fair (1978, 1982, 1988) have analyzed congressional and presidential elections in this manner. Other studies of U.S. voting outcomes have also followed this general research strategy.[1]

Despite the appeal of this method, one limitation is notable. If one restricts attention to the post-war period for the United States, there are only 11 observations for presidential election outcomes, and only 22 observations for congressional elections. It is difficult to draw clear inferences about the influence of economic events on elections given this paucity of data. Fair and Kramer tackled this problem by expanding their sample periods backward in time. For example, Fair (1988) makes use of 18 presidential election observations beginning with the 1916 election. This modestly expands the sample but it also introduces additional perils. Economic data are less reliable for the pre-war period, and voter attitudes about government responsibility for economic conditions are likely to have changed over the course of the century. The idiosyncrasies of two world wars and an unparalleled depression also lead one to question the appropriateness of including earlier observations.

Other researchers have avoided the observation shortage problem by investigating an alternative time series: poll evaluations of presidential performance. For about 40 years, the Gallup Poll has periodically asked respondents whether they approve or disapprove of the incumbent president's handling of his job. Survey results are available for quarterly (or even more frequent) periods, and provide a reasonably long time series which can be linked to economic performance indicators. Many studies have done so; Hibbs (1982a, 1982b, 1987) provides notable recent examples.[2]

Unfortunately, poll data also have limitations. Respondents may have little incentive to respond accurately to survey questions.[3] Even if respondents are truthful, the question posed by the survey is not identical to that of vote choice. The poll question focuses attention on current and past incumbent performance, while voting presumably involves some comparison of alternative future prospects. Moreover, respondent interpretations of poll questions apparently vary over the

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[1] See Paldam (1981) for a review of the literature on voting functions.

[2] Paldam's (1981) review and the recent paper of Dua and Smyth (1989) together provide a comprehensive listing of such studies.

[3] Chilton (1989) shows that poll respondents may have incentives to misrepresent their true preferences.

electoral cycle, requiring additional care in the specification of an empirical model.

One striking feature of the literature on vote functions and political support functions (i.e., approval ratings functions) is that almost all studies are restricted to the analysis of either voting *or* poll responses.[4] This is so even though many researchers apparently view the two data sources as good substitutes for one another, and implicitly accept the premise that vote functions and political support functions are manifestations of the same underlying behavior. If this premise is correct, it is sensible to use *both* data sources rather than to discard one or the other.

In this paper, I jointly estimate vote and political support functions for U.S. presidents. Assuming that voters and survey respondents evaluate economic conditions according to the same standards, cross-equation restrictions are implied for parameters of the two equations. I impose and test these parameter restrictions, in effect testing the hypothesis of "behavioral consistency" for voters and survey respondents. If the hypothesis is rejected, the validity of testing propositions about voting behavior with approval ratings data would be seriously questioned. If it is not rejected, we could be more confident of inferences about voting behavior which are based on approval ratings data.

An econometric model suitable for jointly analyzing vote and approval ratings equations is described in section I below. This is essentially a seemingly unrelated regressions (SUR) model in which there are unequal numbers of observations for the two equations.[5] Section II describes the specifications of equations to explain approval ratings and votes and section III provides empirical results. Conclusions are discussed in section IV.

[4] Hibbs (1987) and others have illustrated that approval ratings and election outcomes are correlated, but have not tested the hypothesis that economic events affect approval ratings and votes in a consistent manner.

[5] Schmidt (1977) has described estimation techniques for the SUR model when there are unequal numbers of observations. Parks (1967) describes methods for handling serially correlated errors in the SUR context. Also see Anderson (1957) on issues related to maximum likelihood estimation methods when there are missing observations.

I. An Econometric Model for Voting and Political Support

I specify a two equation model with one equation determining presidential approval ratings and the other presidential voting:

$$A_t = a + bS_t + cX_t + e_t \tag{1a}$$

$$V_t = \alpha + \beta S_t + \gamma Z_t + u_t, \tag{1b}$$

where

A_t = the percentage answering "approve" in response to the survey question: "Do you approve or disapprove of the way that — is handling his job as president?,"

V_t = the percentage of the two-party vote favoring the party of the incumbent president in the presidential election taking place in quarter t (V_t is observed only in quarters when there is a presidential election),

S_t = a measure of economic performance for quarter t (described in more detail below),

X_t = a vector of other exogenous variables affecting approval ratings,

Z_t = a vector of other exogenous variables affecting presidential votes,

a, b, α, and β are scalar parameters,

c and γ are vectors of parameters.

The error terms, e_t and u_t, are assumed to have a bivariate normal density function $f_{e,u}(e_t, u_t)$ such that $E(e_t) = E(u_t) = 0$, $E(e_t^2) = \sigma_e^2$, $E(u_t^2) = \sigma_u^2$, and $E(e_t u_t) = \sigma_{eu}$ for all t. All cross-time error covariances are initially assumed to equal zero: $E(e_t e_{t-i}) = E(u_t u_{t-i}) = E(e_t u_{t-i}) = E(u_t e_{t-i}) = 0$ for all t and for $i \neq 0$. I later alter the model to permit serially correlated errors in the approval ratings equation.

Economic performance, S_t, will itself be a function of several economic indicators. Previous work has suggested that inflation, unemployment, and economic growth are of interest to voters, so a simple measure of economic performance could take the following form:

$$S_t = \omega_1 \dot{P}_t + \omega_2 U_t + \omega_3 \dot{Y}_t. \tag{2}$$

In this equation $\dot{P}_t$ is the absolute value of a moving average of quarterly inflation rates prevailing under the incumbent president up until period t, and U_t and $\dot{Y}_t$ are similar averages of unemployment and real GNP growth rates. The ω_is are parameters which indicate the relative importance of the various economic performance variables.

Substituting (2) into (1a) and (1b) the two equations of the model can be rewritten:

$$A_t = a + b(\omega_1 \dot{P}_t + \omega_2 U_t + \omega_3 \dot{Y}_t) + cX_t + e_t \quad (3a)$$

$$V_t = \alpha + \beta(\omega_1 \dot{P}_t + \omega_2 U_t + \omega_3 \dot{Y}_t) + \gamma Z_t + u_t. \quad (3b)$$

Note that the ω_is appear in both vote and approval equations, implying that voters and poll respondents use the same standards in evaluating economic performance. This restriction can be tested empirically. Also note that the scale of the linear combination defining S_t is arbitrary; I will normalize by setting $b = 1$ in equation (3a). The likelihood function for the model described above is provided in appendix 1.

Serial correlation of the errors is a potential problem for the approval ratings equation, and the estimation procedure should account for this possibility. Although errors within an administration's tenure are probably correlated there is little reason to believe that the error for the last quarter of an outgoing administration will be correlated with the error for the succeeding administration in its first quarter in office. Letting ϵ_t represent the composite error term for the approval ratings equation, I respecify the error process as follows:

$$\epsilon_t = \rho D_t \epsilon_{t-1} + e_t, \quad (4)$$

where D_t equals one if the administration in office at time t was also in office at time $t - 1$, and is otherwise equal to zero, ρ is the autocorrelation coefficient, and e_t is an error term with the properties attributed to it earlier in equation (1a).

With a data transformation analogous to that used in handling standard first order serial correlation problems, the approval ratings equation can be rewritten in a form in which serial correlation is absent. Consider an equation:

$$y_t = f(X_t, \Theta) + \epsilon_t,$$

where ϵ_t follows the process described by (4). Then the transformed equation:

$$y_t - \rho D_t y_{t-1} = f(X_t, \Theta) - \rho D_t f(X_{t-1}, \Theta) + e_t \quad (5)$$

has a serially uncorrelated error term. Assuming that the approval ratings equation (3a) has been transformed in this manner (given an estimate of ρ),[6] the remaining parameters of equations (3a) and (3b) can be estimated by the maximum likelihood method.[7]

II. Specifying Vote and Approval Ratings Functions

In specifying vote and approval ratings equations I have adopted a conventional approach to measuring economic performance. Following Kramer, Fair, and Hibbs I include recent observations of unemployment, real GNP growth, and the absolute value of inflation as performance indicators. I define these variables as 4-quarter moving averages (including the current quarter) except for early term observations for new administrations. If a new administration has been in office for less than 4 quarters, only within-term observations are used to construct the moving averages.[8] Again following convention, I hypothesize that voters and poll respondents reward higher income growth and penalize higher unemployment and higher inflation.

The simple retrospective voting behavior represented by this specification is compatible with voter naiveté and myopia as assumed by Nordhaus (1975) in his model of the political business cycle. Although the assumption of voter naiveté has been questioned, recent research has shown that similar retrospective voting patterns may also be compatible with rational voting, particularly

[6] Note that the cross-equation error correlation permitted by the model is restricted to the contemporaneous correlation between e_t and u_t.

[7] To obtain an estimate of the autocorrelation coefficient ρ, I first estimated the approval ratings equation by OLS, and constructed the OLS residuals $\hat{e}_t$. I then regressed $\hat{e}_t$, on $D_t \hat{e}_{t-1}$, where D_t is defined as in (4). The coefficient on $D_t \hat{e}_{t-1}$ provides an estimate of ρ. This estimate is used to transform the approval ratings equation as described in (5). The maximum likelihood routine in TSP was then used to estimate the remaining parameters of the model.

[8] In this analysis I consider the Kennedy-Johnson and Nixon-Ford years as single administrations.

when voters are imperfectly informed.[9] Models specifying alternative interpretations of voter sophistication have also been proposed in the literature,[10] but I will not pursue the issues posed by those models here.

Noneconomic variables are also included in each equation, following conventional practice. My selections of noneconomic variables for the approval ratings equation follow the example of Chappell and Keech (1985) closely.[11] To account for an early-term "honeymoon," I include six dummy variables ($POST_k$, $k = 1, 2, \dots, 6$) indicating each of the first six quarters in office for a new administration. The series of dummies permits a flexible honeymoon effect which can persist until mid-term elections are imminent. I also include several variables to control for potentially important political events. Dummies are included to capture the effects of two major scandals, the Watergate events under Nixon (*WATERG*) and the Iran-Contra events under Reagan (*IRAN*). To control for Vietnam war effects, I include a variable indicating the number killed in action during the quarter (*KILLED*). I also allow intercepts to differ for each president in the sample to reflect differences in their personal characteristics, ideological stances, leadership qualities, likely opponents, and other attributes.

My specification for the voting equation is similar to that adopted by Fair. I include a dummy variable (*DEMO*) for the party of the incumbent president to detect any persistent bias favoring one party over the other. I also include a dummy (*DPER*) to indicate that an incumbent president is running for reelection.[12] Precise variable definitions and data sources are listed in appendix 2.

III. Empirical Results

The sample for the approval ratings equation begins with the first quarter of 1953 and continues to the fourth quarter of 1988, and the sample for the voting equation includes presidential elections from 1948 to 1988.[13] Table 1 presents three sets of estimates for the system. Single equation estimates are presented first. The voting equation is estimated by OLS, while the approval ratings equation is estimated by a two-step procedure to correct for serial correlation of the form specified in equation (4). I next provide maximum likelihood estimates of the seemingly unrelated regressions (SUR) model without imposing cross-equation restrictions on the ω_is. Finally, I provide SUR estimates which impose the restriction of equal ω_is across equations.

For both voting and approval ratings equations single equation estimates are similar to the unrestricted SUR model estimates. In the approval ratings equation all coefficient signs follow hypothesized patterns, and most coefficients differ significantly from zero at conventional significance levels. In particular, coefficients for GNP growth and inflation are significant at the 0.01 significance level for two-tailed tests in both sets of estimates. The unemployment coefficient is appropriately negative and moderately large, but is not significantly different from zero.

In the voting equation, economic variables again have expected signs, but none is significant in the OLS estimation. In SUR results, coefficients on GNP growth and inflation have smaller estimated standard errors and are now significant; the unemployment coefficient is now positive but remains insignificant.[14] The cross-equation error covariance for the SUR model is positive and significantly different from zero. This suggests that efficiency gains from the SUR estimation technique are potentially important.

[9] Kramer's original work defended retrospective voting as reasonable given the costs of information gathering and processing, and Beck (forthcoming) has extended this argument while adopting a principal-agent perspective. Alesina and Cukierman (1987), Rogoff and Sibert (1988), and Rogoff (1990) propose models in which rational voters can learn about the competence or preferences of incumbents by observing past and current performance, and Peltzman (1988) observes that rational voters should reward past and current income growth if the income changes are permanent.

[10] Chappell (1983), Chappell and Keech (1985), Minford and Peel (1982), Peltzman (1988), Richards (1988), and Richards and Garman (1988) have proposed models in which voters are assumed to have some understanding of macroeconomic constraints. Alesina and Rosenthal (1989) develop a model in which voters are explicitly prospective and are aware of partisan reputations for differing macroeconomic policy rules.

[11] A detailed discussion of specification issues related to noneconomic variables is provided in that paper.

[12] Fair considers Ford a non-incumbent in constructing this variable; however, I have coded Ford as an incumbent.

[13] Some approval ratings were available for the Truman years; however, polls were not reported with regularity until the Eisenhower presidency.

[14] The standard errors reported here are estimated by the method proposed by White (1982). Inferences are robust to some specification errors when this method is employed.

TABLE 1.—ESTIMATED VOTING AND APPROVAL RATINGS EQUATIONS
(ASYMPTOTIC t-STATISTICS IN PARENTHESES)

	Single Equation Estimates		Unrestricted SUR Estimates		Restricted SUR Estimates	
Parameter	Estimate	t-statistic	Estimate	t-statistic	Estimate	t-statistic
σ_{eu}	—	—	15.612	(2.190)[a]	11.701	(1.430)
Approval Equation Parameters						
σ_e^2	24.098	—	21.303	(7.124)[a]	21.265	(6.762)[a]
ρ	0.535	—	0.535	—	0.535	—
EISEN	69.094	(16.296)[a]	69.176	(11.141)[a]	66.785	(10.908)[a]
KENNEDY	66.714	(11.840)[a]	66.825	(10.070)[a]	63.340	(9.552)[a]
JOHNSON	61.487	(12.061)[a]	61.119	(10.063)[a]	57.864	(9.193)[a]
NIXON	62.890	(11.464)[a]	62.504	(10.441)[a]	59.233	(7.755)[a]
FORD	64.447	(8.585)[a]	67.564	(6.672)[a]	61.772	(7.073)[a]
CARTER	60.580	(8.597)[a]	61.125	(7.548)[a]	56.461	(5.797)[a]
REAGAN	63.582	(9.411)[a]	64.112	(7.605)[a]	59.192	(6.829)[a]
$POST_1$	12.788	(5.855)[a]	12.785	(4.060)[a]	12.911	(4.191)[a]
$POST_2$	13.699	(5.844)[a]	13.631	(5.081)[a]	13.883	(5.331)[a]
$POST_3$	9.556	(3.985)[a]	9.575	(4.710)[a]	9.793	(4.924)[a]
$POST_4$	−8.888	(3.747)[a]	8.138	(4.722)[a]	8.516	(5.255)[a]
$POST_5$	8.760	(3.837)[a]	8.392	(4.219)[a]	8.635	(4.457)[a]
$POST_6$	2.404	(1.241)	2.244	(1.452)	2.319	(1.512)
KILLED	−1.872	(−1.805)[a]	−1.573	(−1.899)[a]	−1.481	(−1.613)[a]
WATERG	−16.433	(−3.788)[a]	−14.790	(−3.259)[a]	−15.725	(−3.399)[a]
IRAN	−5.624	(−1.430)	−5.690	(−1.684)[a]	−5.162	(−1.699)[a]
$\dot{P}$	−1.591	(−3.379)[a]	−1.726	(−3.308)[a]	−1.551	(−2.766)[a]
$\dot{Y}$	0.901	(3.496)[a]	0.886	(3.840)[a]	0.940	(4.389)[a]
U	−1.003	(−1.299)	−0.981	(−0.989)	−0.507	(−0.509)
Voting Equation Parameters						
σ_u^2	21.377	—	16.503	(2.029)[a]	13.154	(2.533)[a]
CONSTANT	55.350	(7.092)[a]	49.112	(10.649)[a]	54.319	(13.754)[a]
DEMO	−4.105	(−1.091)	1.671	(0.574)	−0.476	(−0.103)
DPER	6.504	(1.738)[a]	2.951	(1.173)	5.289	(1.796)[a]
$\dot{P}$	−0.951	(−1.145)	−1.346	(−2.960)[a]	−1.551	(−2.766)[a]
$\dot{Y}$	0.935	(1.111)	1.189	(2.741)[a]	0.940	(4.389)[a]
U	−0.673	(−0.495)	0.418	(0.504)	−0.507	(−0.509)
β	1.0	—	1.0	—	0.823	(2.176)[a]
Log-likelihood function	—	—	−450.21	—	−451.19	—

Note: Wald test of restrictions imposing equality of the ω_is across equations: $\lambda_W = 2.73 < 4.61 = \chi^2_{0.90}(2)$. The restrictions are not rejected. Likelihood ratio test of restrictions imposing equality of the ω_is across equations: $\lambda_{LR} = 1.978 < 4.61 = \chi^2_{0.90}(2)$. The restrictions are not rejected.
[a] Significant at the 0.10 level.

Although the impacts of economic variables are qualitatively similar in the approval and voting equations, there are some notable differences in magnitudes. In the approval equation, the inflation coefficient is almost twice as large as the GNP growth coefficient, but in the voting equation the two coefficients are comparable in magnitude. Despite the apparent differences, a Wald test cannot reject the hypothesis of equal ω_is across equations at the 0.10 significance level. This result is confirmed by a likelihood ratio test based on restricted and unrestricted SUR estimates. Given the paucity of voting equation observations and the resulting low power of these tests, we should interpret such results cautiously —a failure to reject the restrictions does not imply that we should accept them. A "failure to reject" the restrictions is perhaps best considered a minimal requirement for researchers who are inclined to impose such restrictions a priori.

SUR estimates which impose the restriction of equal ω_is confirm the importance of GNP growth and inflation as performance indicators; the unemployment coefficient is again insignificant. In the voting equation, β (measuring the overall sensitivity of voting to economic performance) is positive and significantly different from zero, indicating that the linear combination of performance measures does influence voting. The estimate of β is less than one, but not significantly so. A value of β less than one indicates that economic performance has a smaller percentage impact on voting than on approval ratings. This is reasonable if voting decisions depend more heavily on omitted prospective variables (like policy positions) than approval ratings do.

Robustness of the results to alternative specifications is, as always, an issue of concern. In this paper I have not searched for a "best" specification of economic performance indicators; rather I have selected a specification which is broadly representative of the existing literature.[15] Whether alternative models of voter behavior would lead to different implications about the consistency of the behavior patterns producing voting and approval rates provides a question for future research efforts. I have, however, done some sensitivity testing with alternative specifications of the noneconomic variables in the approval ratings equation. These tests will be briefly described here; detailed results are available from the author upon request.

I first considered variations in the handling of honeymoon effects and political events. Omitting any or all of the political events variables has no substantive effects on reported results, nor does replacing the series of honeymoon dummies with a declining linear trend over the early quarters of a president's tenure. In each case, the cross-equation restrictions implying behavioral consistency cannot be rejected.

I next replaced the president-specific intercepts with a common intercept and a party dummy. Since a Wald test based on the original unrestricted SUR estimates does not reject the hypothesis of equal presidential intercepts, this represents a reasonable reformulation of the model. Coefficient estimates are similar to those reported earlier, but the impacts of inflation relative to growth are a bit larger in the approval equation and a bit smaller in the voting equation, making the differences between equations more pronounced. More importantly, estimated standard errors for the coefficients of economic variables in the approval equation are notably smaller, and the hypothesis of behavioral consistency is now rejected at the 0.01 significance level.[16] This result considerably strengthens earlier suggestions of stronger inflation aversion in poll responses than in voting.

In further sensitivity testing, I have estimated the model for a sample which adds the eight elections from 1916 to 1944 to the voting equation. Under the assumption that voting was stable over the 1916 to 1988 period, the consistency of voting and approval ratings is again rejected—and the polls again indicate greater inflation aversion. This adds force to the view that voting and poll responses differ, but it is contingent on the questionable assumption of voting function stability over the pre-war and post-war periods. The test of behavioral consistency in this case confounds differences between voting and poll responses with variations in voting behavior over time. Although the hypothesis of a stable voting function cannot be rejected at the usual significance levels, there are at least suggestions of voting instability.[17] Thus, while the sensitivity tests strengthen the case against the hypothesis of behavioral consistency, conclusions must remain somewhat clouded.

IV. Summary and Conclusions

In this paper I have jointly estimated equations explaining presidential voting and presidential approval ratings, treating the equations as seemingly unrelated regressions with unequal numbers of observations. My results are broadly consistent with previous voting and approval rating studies of Fair, Hibbs, and others. GNP growth and inflation appear to matter for both voters and poll respondents; evidence of unemployment effects is weak. Since the results are qualitatively

[15] I have also estimated a model dropping the insignificant unemployment variable, obtaining results similar to those described here.

[16] For the Wald test of the hypothesis of equal $\omega_i s$ across equations we obtain $\lambda_w = 13.128 > 9.21 = \chi^2_{0.99}(2)$; the hypothesis is rejected.

[17] For a Wald test of the hypothesis of stable coefficients for the economic variables in pre-war and post-war periods, we obtain $\lambda_w = 3.60 < 6.25 = \chi^2_{0.90}(3)$; the hypothesis is not rejected. However, in results for the extended sample, the unemployment coefficient in the voting equation has an implausible positive sign. If unemployment is dropped from the model, then inflation coefficients differ significantly over the pre-war and post-war periods, and stability of the vote function is rejected.

similar for voters and poll respondents, it appears that the poll results provide meaningful evaluations which are related to voting decisions.

The results also point to some differences in the behavior of voters and poll respondents, however. Estimates consistently, if not strongly, indicate that poll respondents are more concerned with inflation and less concerned with GNP growth than voters are. The hypothesis that voters and poll respondents employ identical standards in evaluating economic performance is not rejected in the original specification, but can be rejected in some plausible reformulations of the model. Given these results it is reasonable to remain cautious regarding the interchangeability of voting data and poll data.

When considering why voting and approval ratings might differ in their responses to economic indicators, distinctions between retrospective and prospective considerations are likely to be important. The focus of the approval question on job performance may encourage retrospective evaluations, while voting may be more heavily influenced by prospective criteria. If recent GNP growth is a better "leading indicator" than the rate of inflation, then the results reported here are consistent with a more prospective outlook by voters.

APPENDIX 1

Likelihood Function for the Voting and Approval Ratings Model

Below I provide the log-likelihood function for individual observations under 3 cases: (1) the presidential vote is observed, but an approval rating is not observed, (2) there is no presidential election, but an approval rating is observed, and (3) both the presidential vote and an approval rating are observed. First define e_t^* and u_t^* as follows:

$$u_t^* = V_t - a - \left(\omega_1 \dot{P}_t + \omega_2 U_t + \omega_3 \dot{Y}_t\right) - cX_t$$

$$e_t^* = A_t - \alpha - \beta\left(\omega_1 \dot{P}_t + \omega_2 U_t + \omega_3 \dot{Y}_t\right) - \gamma X_t.$$

The log-likelihood function for observations in the various cases is provided below:

Case I. Vote observed, approval rating not observed:

$$\log(L_t) = -0.5\log\left(2\pi\sigma_u^2\right) - 0.5(u_t^*/\sigma_u)^2.$$

Case II. Vote not observed, approval rating observed:

$$\log(L_t) = -0.5\log\left(2\pi\sigma_e^2\right) - 0.5(e_t^*/\sigma_e)^2.$$

Case III. Vote observed, approval rating observed: Let $D = (\sigma_u^2\sigma_e^2 - \sigma_{eu}^2)$, then

$$\log(L_t) = -\log(2\pi) - 0.5\log(D) - \sigma_u^2/2D\big)(e_t^*)^2 - \left(\sigma_e^2/2D\right)(u_t^*)^2 + (\sigma_{eu}/D)e_t^* u_t^*.$$

The log-likelihood function for the sample is the sum of the log-likelihoods for the individual observations.

APPENDIX 2

Data Definitions and Sources

V	The incumbent party's percentage of the 2-party vote in a presidential election. Source: Fair (1978) and the *Statistical Abstract of the United States*.
A	The percentage of respondents answering "approve" to the Gallup Survey question: "Do you approve or disapprove of the way that __ is handling his job as president?" Source: various issues of the *Gallup Report*, the *Gallup Opinion Index* and the *Gallup Political Index*. This variable is computed as an average across all polls conducted within a quarter. I have interpolated to obtain values for three quarters in which no polls were reported.
$POST_k$	A dummy variable equal to 1 in the k^{th} quarter of a new administration's tenure ($k = 1, \ldots, 6$); else equal to 0.
EISEN *KENNEDY* *JOHNSON* *NIXON* *FORD* *CARTER* *REAGAN*	A series of dummy variables indicating, respectively, Presidents Eisenhower, Kennedy, Johnson, Nixon, Ford, Carter, and Reagan. Each dummy is equal to 1 for quarters during the indicated presidency and is otherwise equal to 0.
WATERG	A dummy variable equal to 1 for the period 1973 4 to 1974 2 (beginning with the firing of Archibald Cox and continuing until Nixon's resignation); else equal to 0.
IRAN	A dummy variable equal to 0.5 for 1986 4, equal to 1 for 1987 1 to 1987 4, and otherwise equal to 0. Note: Only one of the two polls administered in 1986 4 came after the revelation of the arms-for-hostages negotiations with Iran. The congressional Iran-Contra committee submitted its final report in 1987 4.
KILLED	The number (in thousands) of servicemen killed in action in Vietnam in the quarter. Sources: Milstein (1974) and the *Statistical Abstract of the United States*
$\dot{P}$	If the current administration has been in office at least 4 quarters, $\dot{P}$ is the absolute value of a 4-quarter moving average of quarterly inflation rates. If the current administration has been in office for less than 4 quarters, $\dot{P}$ is the average of the absolute values of inflation rates within the administration's term. The inflation rate is computed as an annualized percentage change in the GNP deflator. Source: CITIBASE data tape.

U	If the current administration has been in office at least 4 quarters, U is a 4-quarter moving average of the quarterly percentage unemployment rate. If the current administration has been in office for less than 4 quarters, U is the average of unemployment rates within the administration's term. Source: CITIBASE data tape.
$\dot{Y}$	If the current administration has been in office at least 4 quarters, $\dot{Y}$ is a 4-quarter moving average of the annualized percentage quarterly growth rate of real GNP. If the current administration has been in office for less than 4 quarters, $\dot{Y}$ is the average of the growth rates within an administration's term. Source: CITIBASE data tape.
DEMO	A dummy variable equal to 1 when the incumbent president is a Democrat; else equal to 0.
DPER	A dummy variable equal to 1 in quarters when an incumbent president runs for reelection; else equal to 0.

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