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Unraveling the Relationship between Presidential Approval and the Economy
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A Multi-Dimensional Semi-Parametric Approach

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Abstract

Empirical studies analyzing the determinants of U.S. presidential popularity have delivered quite inconclusive results concerning the role of economic variables by assuming linear relationships. We employ penalized spline smoothing in the context of semiparametric additive mixed models and allow for flexible functional forms and thus possible non-linear effects for the economic determinants. By controlling for the well-known politically motivated covariables, we find strong evidence for non-linear and negative effects of unemployment, inflation, and government consumption on presidential approval. Additionally, we present new results in favor of non-parametric trivariate interaction effects between the macroeconomic covariables.

Keywords: Presidential Popularity, Macroeconomy, Semi-Parametric Regression, Penalized Splines

JEL classification: C14, C22, C54, E02, H11

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1 Introduction

In the aftermath of the pioneer work of Mueller (1970), a quickly growing empirical literature on the determinants of the popularity of U.S. presidents evolved. While it is more or less uncontroversial in this literature that political events as well as foreign conflicts have significant effects on presidential popularity, the influence of the state of the economy on presidential approval is less clear. Although there is a widespread belief that voters hold governments accountable for economic outcomes (see, e.g., Fair 1978, Norpoth 1984, Kiefer 1997, Faust and Irons 1999, Gronke and Brehm 2002) the empirical evidence summarized in Berlemann and Enkelmann (2012) indicates that the effects of economic variables on presidential popularity vary enormously among existing studies. While proxies of inflation turned out to be significant in roughly 60% of all reported estimations, unemployment variables performed even worse, delivering significant and plausible coefficients in only about half the studies in which they were used. Berlemann and Enkelmann (2012) also show that the coefficients of economic variables turn out to be highly unstable when running the typically employed linear regression models for randomly chosen sub-periods. A possible reason for this finding is the inadequacy of the typically employed linear regression approach. Whenever the "true" relationship between presidential popularity and variables mirroring the state of the economy is non-linear, the findings of linear regressions will strongly depend on the chosen sample period.

Thus far, non-linear and less restrictive estimation approaches have rarely been used to estimate popularity functions. A few studies (e.g., Mueller 1970) employ asymmetrically defined economic variables to account for possible non-linearities. A few others (see, e.g., Smyth et al. 1991, 1994, 1995, 1999, Smyth and Taylor 2003) use squared economic variables in their linear regressions, thereby assuming the detrimental effects of unemployment and inflation to be smaller at lower levels of inflation and unemployment. However, while these approaches are the first steps towards a more general analysis of the effects of economic variables on presidential popularity, they nevertheless again make special and thus highly controversial assumptions on the exact type of non-linearity we possibly deal with.

In this paper, we go beyond the existing approaches and employ more flexible and non-linear estimation techniques to study the relation between U.S. presidential popularity and (possibly) important economic variables such as inflation, unemployment, and government consumption. In order to do so, we use penalized spline smoothing in the context of semi-parametric additive mixed models. With the latter, the economic variables enter the estimation equation as a-priori unspecified functions to be estimated from the data. As a consequence, the relation between presidential popularity and economic variables might take any functional form. While we start out by studying additive effects, we also investigate possible high-dimensional interaction effects between the economic covariates. While our focus is on the economic determinants of presidential popularity, we also allow for a non-linear time-in-office effect and non-linear effects of large wars on presidential popularity. Political events as well as smaller foreign conflicts enter the estimation equation in the form of binary-coded variables and therefore in line with the existing literature (see Newman and Forcehimes 2010).

We find significant non-linear effects for unemployment and inflation, while government consumption (as a percentage of GDP) turns out to have an almost linear negative effect on presidential popularity. While the unemployment rate has little effect on presidential popularity when unemployment levels are low, increases in the unemployment rate exceeding a threshold level of about 4% turn out to be detrimental to presidential popularity. Rising inflation rates in general tend to be harmful for the president. However, the strength of the effect depends strongly on the level of inflation. For inflation rates between 4% and 7%, presidential popularity tends to be unaffected by the economy's inflation performance. We also find supporting evidence for a general decline of presidential approval over time, although this is reversed about one year before a presidential election. Moreover, we detect significant *honeymoon* effects.

Interestingly, we find strong evidence for the existence of interaction effects between the economic covariates. Allowing for interaction effects between the economic covariates increases the explanatory power of the estimation results significantly. We might take this as an indication that the usually assumed additivity (or even linearity) of the effects of economic variables on presidential popularity is misleading. In reality, voters seem to make judgments on the economic situation and the government's undertaken measures as a whole.

The paper is organized as follows: the second section delivers a brief overview of the related literature. The third section introduces the applied non-linear estimation technique. Section 4 describes the employed dataset. The estimation results are presented and discussed in section 5. In section 6, the analysis is extended to interaction effects between inflation, unemployment, and government consumption. Section 7 summarizes and draws conclusions.

2 Review of the Related Literature

Due to the large interest of economists and political scientists, an extensive body of literature on vote and popularity functions has evolved over the last four decades.[1] The relationship between public support and the economy constitutes an essential building block of politico-economic models (e.g., Frey and Schneider 1978, 1981) that give up the bold assumption of an exogenous government sector.[2] Moreover, vote and popularity functions can be used to approximate social welfare functions (Smyth et al. 1991, Paldam 2008) that help to guide political decision-makers.

Vote and popularity functions have been estimated for numerous countries and different sample periods. The existing empirical studies differ considerably in the economic and political variables used as well as the employed estimation techniques and model specifications. We make no attempt to summarize this literature here at length.[3] Instead, we focus our review on whether and how the existing studies control for possible non-linearities between presidential popularity and economic variables.

The vast majority of empirical popularity studies assume a linear relationship between presidential approval and its determinants. In these studies (e.g., MacKuen et al. 1992, Burden and Mughan 2003, Geys 2010, Newman and Forcehimes 2010), the employed popularity measure is typically regressed on the level of a number of political and

[1] It should be noted that *approval* and *popularity* are "conceptionally distinct" (Stimson 1976). However, we will neglect this semantic subtlety and use the terms *popularity*, *approval*, and *political support* interchangeably, as it is common in the field.

[2] In a more recent paper, Meltzer (2011) also comes to the conclusion that "the appropriate model for policy analysis is a political economy model."

[3] For recent overviews of the literature see, for example, Paldam (2008), Bellucci and Lewis-Beck (2011), and Berlemann and Enkelmann (2012).

economic variables using the ordinary least squares estimator (OLS). Somewhat surprisingly, this standard approach has rarely been questioned or discussed.

Interestingly, it was the pioneer study by Mueller (1970) that experimented with a (quasi) non-linear relationship between economic conditions and presidential approval. Mueller's (1970) *economic slump* variable is generally defined as the difference between the unemployment rate at the time of the poll and the unemployment rate at the beginning of the president's term, but it is set to zero whenever this difference is negative. For a particular presidency, this transformation implies a kinked hence non-linear relationship between government popularity and the unemployment rate. The introduction of this sort of non-linearity, however, was not motivated by economic or political theory, but was rather chosen to make the data "come out right" (Mueller 1970, p. 23).

Smyth, Washburn, and Dua (1989) argue that "[t]he linearity assumption is inconsistent with standard utility theory" since such popularity functions produce a "preference map [that] consists of linear indifference curves." As a consequence, Smyth and his co-authors addressed the issue of non-linearity in a number of papers by using the squared terms of unemployment and inflation in popularity functions (Smyth et al. 1991, 1994, 1995, 1999, Smyth and Taylor 2003).[4] A negative coefficient of a squared variable implies that the detrimental effects of these variables increase in the level of the referring variable. In general, Smyth and his co-authors find supporting evidence for squared economic variables such as inflation and unemployment. From an econometrical perspective, however, the choice of squared terms is as arbitrary as using a linear specification. Moreover, the authors include a quadratic but no linear term of unem-

[4]To our knowledge, Yantek (1988) was the first to include squared economic variables in a popularity function.

ployment and inflation, thereby forcing the quadratic function to be symmetrical to the ordinate axis. Doing so is questionable, too.

Bellucci and Lewis-Beck (2011) use interaction terms to model non-linear effects. In their cross-national study, the authors examine the interaction of the perception of the state of the economy with a *clarity of responsibility* variable. The rationale behind this approach is that a worsening of economic conditions has a stronger effect on approval ratings when this development can clearly be assigned to a single party or person. In times of divided governments, the impact of the economy on approval rates should be smaller. However, Bellucci and Lewis-Beck (2011) find no significant effect for the interaction term. Hence, they find the relationship between presidential approval and the economic conditions to be linear.

Non-linearities have also been studied for non-economic determinants of presidential approval. Repeatedly, the impact of time has been modeled in a non-linear fashion to capture the dynamics of presidential approval over the electoral cycle (e.g., Bellucci and Lewis-Beck 2011, Stimson 1976). Often, it is assumed that government popularity follows a U-shaped pattern between two elections: a honeymoon period followed by a phase of decline and, finally, a pre-election rebound caused by campaign or farewell effects. In their early study of U.K. government popularity, Goodhart and Bhansali (1970) call this pattern the "natural path of government popularity." Bellucci and Lewis-Beck (2011) include both a time-in-office variable and its squared counterpart to study the existence of a U-shaped time pattern. However, the use of a linear-quadratic functional form is again arbitrary.

Summing up, one might conclude that the issue of non-linearities has only rarely been touched upon in the vote and popularity function literature. While linear estimation approaches dominate the literature, the concrete functional form of the covariates has almost always been chosen in an arbitrary and rather predefined way. One might suspect that the shortcoming to allow for more complex, possibly non-linear relationships between popularity and its determinants has contributed to the inconclusive findings of the existing literature on the (economic) determinants of presidential approval.

3 Estimation Approach

As outlined in the previous section, the predominant approach of estimating popularity functions follows the idea of the response or endogenous variable y depending on the covariates $x_1, \ldots, x_p$ in a linear fashion:

$$y_i = \beta_0 + x_{i1}\beta_1 + \cdots + x_{ip}\beta_p + \epsilon_i, \tag{1}$$

with $\epsilon \sim N(0, \sigma^2)$ for $i = 1, \ldots, n$.

Although the linear approach is both computationally efficient and easy to interpret, it might be too simplistic to estimate a presidential popularity function with respect to the underlying time series from 1953 to 2006. We therefore rely on a more general approach and employ a semi-parametric additive mixed model, which was introduced in the statistical literature by a number of studies, including Ruppert et al. (2003), Wood (2006), and Zuur et al. (2008).

The standard model (1) is thereby a special case of

$$y_i = f(x_{i1}, \ldots, x_{ip}) + \epsilon_i, \tag{2}$$

with $f(\cdot)$ being an unknown function quantifying the relationship of the p covariates on the response y_i. As a first step, we impose the assumption of additivity on (2) and ease the rather strong assumptions of linearity in (1) by replacing the structure with a functional and additive form

$$y_i = \beta_0 + f_1(z_{i1}) + \ldots + f_q(z_{iq}) + x_{i1}\beta_1 + \ldots + x_{ip}\beta_p + \epsilon_i, \tag{3}$$

with $Z = (z_{ij}), i = 1, \ldots, n; j = 1, \ldots, q$ consisting of q metrically scaled covariates and $X = (x_{im}), i = 1, \ldots, n; m = 1, \ldots, p$ consisting of p binary-coded indicator covariates. In (3), $f_r(z_{ir}) \, \forall \, r \in \{1, \ldots, q\}$ are assumed to be sufficiently smooth but a-priori otherwise unspecified functions in the corresponding ranges of the covariates to be estimated from the data. Models of form (3) have been termed additive models by Hastie and Tibshirani (1990), and are extensively discussed in Wood (2006). Following Ruppert et al. (2003) and Fahrmeir et al. (2009), model (3) is a *semi-parametric* additive model because binary-coded covariates in X (and the intercept β_0) enter the model in a linear way. For more details about the resulting idea of Penalized Spline Smoothing and an economic application, we refer to Arin et al. (2013).

The statistical literature extensively discusses the possibility of representing penalized regression in the context of mixed models in order to obtain an optimal values of the penalization parameters λ_j, which steer the amount of smoothness for the resulting functional effects $\hat{f}_j(\cdot)$, from the data (see Wahba 1978, Wong and Kohn 1996, and Wood 2000). By interpreting the penalty component as a (Bayesian) prior on the spline coefficient vectors b_j, model (3) changes to

$$y_i = \beta_0 + \sum_{j=1}^{q} B_j(z_j) b_j + \sum_{u=1}^{p} x_u \beta_u + \epsilon_i \tag{4}$$

with $b_j \sim N(0, \sigma_b^2)$, $\epsilon_i \sim N(0, \sigma_\epsilon^2)$ and $B_j(\cdot)$ as a high-dimensional basis representation of the underlying data, covering the entire range of the corresponding covariate z_j. The latter can be constructed using popular cubic smoothing splines (see Wahba 1978 and de Boor 2001). Although $B_j(\cdot)$ is high-dimensional, the Bayesian formulation in (4) is a well-known linear mixed model (LMM), as described by Searle et al. (1992), McCulloch and Searle (2001) and Zuur et al. (2008). By following the corresponding criterion for Best Linear Unbiased Predictors (BLUP) $\hat{b}_j = \hat{E}(b_j|y)$ in LMMs, Ruppert et al. (2003) show that the penalization parameter becomes a variance component of the random effect, and it follows that an optimal parameter steering the amount of smoothness is found by

$$\hat{\lambda}_j = \frac{\hat{\sigma_\epsilon^2}}{\hat{\sigma_{b_j}^2}}. \tag{5}$$

The estimation of the two variance components in (5) can either be carried out using the maximum likelihood (ML) or the restricted maximum likelihood (REML) technique. Because of the large numbers of strictly parametric components in the model (see Section 4), the ML based estimations of σ_ϵ^2 and $\sigma_{b_j}^2$ tend to be "badly biased" (see Wood 2006). We therefore employ the REML technique, which integrates out the fixed parameters of the joint likelihood and allows for a more reliable estimation. For the technical details about REML, see Ruppert et al. (2003) and Fahrmeir et al. (2009).

To conduct an analysis with the data at hand we must modify and amend the above-mentioned models with respect to one additional aspect: presidential approval, our response variable, is compiled on a monthly basis and therefore likely to be affected by unobserved effects in the short run. It is reasonable to assume that these effects occur randomly. We therefore supplement model (4) by a latent monthly-specific effect, leading to

$$y_i = \beta_0 + \sum_{j=1}^{q} B_j(z_j)b_j + \sum_{u=1}^{p} x_u\beta_u + t_{i0} + \epsilon_i \tag{6}$$

with $t_{i0} \sim N(0, \sigma_t^2)$ being interpreted again in a Bayesian context and in addition with all of the above mentioned assumptions. t_{i0} allows for random monthly deviations from β_0 and controls for serial correlation in the dataset. Note that serial correlation is likely since the underlying data is a multivariate time series. Fitting can be carried out employing the same technique as mentioned above since (6) is only a minor extension of (4) with respect to the parameters and is therefore again a LMM being estimated numerically with the help of REML.

The described estimation technique is implemented in R (see Pinheiro and Bates 2000 and R Development Core Team 2010). We make use of the R-package `mgcv` (see Wood 2011), which allows for a computationally stable and reliable estimation.

4 Data and Estimation Equation

Our empirical analysis is based on monthly observations dating from January 1953 through December 2006. Thus, the sample data covers the ten U.S. presidents from Dwight D. Eisenhower through George W. Bush.

The endogenous variable, presidential approval, is defined as the average share of survey respondents answering positively to the following Gallup question: "Do you approve or disapprove of the way *[name of the president]* is handling his job as president?" Approval ratings are limited to a [0,100] interval, although actual values range between 23 (Watergate) and 88 (9/11 attacks). Since there are 45 months in which Gallup did not conduct the relevant surveys, our sample size is reduced from 648 to 603 months.

TABLE 1
SUMMARY STATISTICS, 1953–2006

variable	**obs**	**mean** [%]	**std. dev.**	**min** [%]	**max** [%]
approval	603	55.4	12.0	23.0	88.0
unemployment	648	5.7	1.5	2.5	10.9
inflation	648	3.9	2.9	-0.9	14.6
govt. consumption	648	13.2	1.5	8.9	15.6

In this study, three economic determinants of presidential approval are considered: (a) the seasonally adjusted, civilian unemployment rate, (b) the seasonally adjusted inflation rate, defined as the percentage change of the CPI over the previous 12 months, and (c) government consumption as a percentage of GDP.[5] Two of these, unemployment and inflation, are frequently used in the vote and popularity function literature. As a third variable, we add government consumption as a percentage of GDP to control for the government's fiscal policies. Tables 1 and 2 display descriptive statistics for the sample period and for each presidency.

Starting with Mueller (1970), it has been repeatedly shown that presidential popularity tends to decline over time, probably in consequence of the so-called *cost of ruling*

[5] All series are taken from the FRED database. The employed series are *UNRATE* (unemployment), *CPIAUCSL* (inflation), and *GCE* less *FDEFX* (government consumption without military expenditures) as a share of GDP. Since the government consumption ratio is only available on a quarterly basis, we use the same quarterly value for each month during that quarter.

TABLE 2
PERFORMANCE BY PRESIDENT, 1953–2006

president	**approval** [%]	**unemployment** [%]	**inflation** [%]	**govt. cons.** [%]
Eisenhower	64.3	4.9	1.4	10.1
Kennedy	70.0	6.0	1.2	11.8
Johnson	54.0	4.2	2.6	12.8
Nixon	48.9	5.0	5.6	14.1
Ford	46.7	7.8	8.2	15.2
Carter	45.5	6.5	9.7	14.2
Reagan	52.5	7.5	4.7	13.6
Bush I	59.5	6.3	4.4	13.9
Clinton	54.6	5.2	2.6	13.7
Bush II	55.1	5.3	2.7	14.3
Total	55.4	5.7	3.9	13.2

(see Paldam 2008), although some authors criticize the use of time as an explanatory variable (e.g., Kernell 1978). Additionally, the literature suggests that presidents enjoy a *honeymoon* period during the first months as well as rebound effects (*nostalgia*) at the end of their presidencies (see, e.g., Geys 2010). To capture all these potential influences, a *time-in-office* variable is included that takes on a value of zero in the first month of each presidency and increases linearly with every additional month in office. Since we allow the president's time-in-office variable to enter the estimation equation in a non-linear fashion, a single variable is able to account for all three time-related effects. In contrast to the existing literature, we thus do not have to impose any arbitrary assumption on the magnitude and duration of these effects.

Finally, we add a number of non-economic control variables to our model. Following Newman and Forcehimes (2010), we include binary-coded variables to capture the effect of politically relevant events like the Cuban Missile Crisis, the Iran hostage crisis, or the fall of Baghdad in April 2003. Altogether, we control for 120 events that are grouped together in eight variables. The variables include positive as well as negative events in four categories: *personal*, *domestic*, *international*, and *diplomatic*.[6] Additionally, because of their extraordinary impact, two separate dummy variables are included for the Watergate affair and the 9/11 terror attacks, respectively. To account for the effect of major military conflicts, a dummy variable for the short Gulf War (Operation *Desert Storm*) as well as monthly casualty figures for the wars in Vietnam, Afghanistan, and Iraq are included.[7] Moreover, a dummy variable for divided governments is employed to control for the clarity of responsibility of the reigning president (Powell and Whitten 1993). Binary-coded variables for each president are included to control for unobserved, president-specific effects. We chose Bill Clinton as the reference point since none of the major political events or wars fell into his period of office, which lasted 96 months.

The equation to be estimated is thus

[6] Among other criteria, extensive front page coverage in the *New York Times* is a necessary requirement for the inclusion of events. Since there was no event in the *negative diplomatic* category, we end up with seven binary event variables. For a complete event list and details about the selection method, see Newman and Forcehimes (2010).

[7] The Gulf War dummy is one from January 1991 to September 1991. Casualty figures were obtained from the National Archives (Vietnam) and the Department of Defense.

$$
\begin{aligned}
approval_i &= \beta_0 + f_1(inflation_i) + f_2(unemployment_i) \\
&+ f_3(gov.consumption_i) + f_4(time.in.office_i) \\
&+ f_5(vietnam.casualties_i) \\
&+ f_6(afghanistan.casualties_i) \\
&+ f_7(iraq.casualties_i) \\
&+ X\beta + t_{i0} + \epsilon_i. \qquad (7)
\end{aligned}
$$

Our response variable $approval_i$ is limited to the interval [0,1] by definition. We nevertheless assume normality for our model since doing so allows us estimating (7) and later (8) in a numerically stable way.[8] However, as Figures 2 and 5 reveal, the fitted values $\widehat{approval}_i$ in our approach all lie in the interval [0,1] thereby indicating our estimation approach to be justified.

5 Results

Before turning to the (potentially) non-linear determinants of presidential approval, we discuss the results for the binary covariates (matrix X) in model (7), which are displayed in Table 3.

[8] Fractional-data models employing a Maximum-Likelihood approach (see Papke and Woolridge 1996) are yet not available for semi-parametric estimation approaches.

First, we find highly significant effects of the three major events for which we control. While the Watergate affair exerted a negative effect on presidential popularity, Operation Desert Storm and 9/11 each had a positive rally effect.

Second, the controls for positive political events all deliver the expected positive sign and turn out to be significant in three out of four categories (domestic, foreign and personal). Among the negative political events, only domestic events have a significant effect on presidential popularity. While negative personal events also deliver a slightly negative coefficient, it is insignificant. The estimated coefficient of negative foreign events is positive, very small, and highly insignificant. Altogether, the effects of the political event dummies turn out to be highly plausible.

Third, we find a significantly positive effect of divided governments on presidential popularity. During these times, presidential approval is significantly higher since negative political and economic outcomes can not be attributed to the president alone. This result is in line with the clarity of responsibility hypothesis.

Fourth, after having controlled for all other political, personal, and economic effects, we find that Presidents Kennedy, Johnson, Carter, Reagan, and Bush Jr. reached significantly higher popularity scores compared to the Clinton administration. However, the president dummies should be interpreted with some caution, since some of the political events or affairs are directly linked to the person of the ruling president, such as the Watergate affair.

The estimation results for the variables entering the estimation equation as a-priori unspecified functions are visualized in Figure 1. The displayed diagrams show the functional effects $\hat{f}_j(\cdot)$ of the referring covariates on the presidential popularity. Note, that the latter effects have to be centered around zero for reasons of identifiability,

TABLE 3

PARAMETRIC ESTIMATION RESULTS OF MODEL (7)

covariate	$\hat{\beta}_j$	p-value
(Intercept)	0.44	< 0.01
watergate	-0.16	< 0.01
desert.storm	0.25	< 0.01
nine.eleven	0.11	0.03
neg.domestic	-0.02	0.04
neg.foreign	0.001	0.94
neg.personal	-0.003	0.81
pos.domestic	0.06	0.04
pos.foreign	0.05	< 0.01
pos.diplomatic	0.02	0.18
pos.personal	0.05	0.02
divided.gov	0.14	< 0.01
Eisenhower	-0.04	0.3
Kennedy	0.11	< 0.01
Johnson	0.1	< 0.01
Nixon	0.02	0.12
Ford	0.01	0.69
Carter	0.1	< 0.01
Reagan	0.04	0.04
BushSr	-0.01	0.59
BushJr	0.06	< 0.01
$Var(\hat{t}_{i0})$	0.02	–

see Fahrmeir et al. (2009) for details. The shaded areas depict the 95% point-wise confidence bands.

Inflation For inflation rates below 10%, we find an monotonic, negative relationship between inflation and popularity. However, this relationship turns out to be non-linear (for a similar result based on parametric estimation methods, see Carlsen 2000). As inflation increases from very low levels to roughly 4%, presidential popularity decreases significantly. For example, a rise in inflation from 0% to 4% decreases presidential popularity by almost 10 percentage points. In the range in between 4% and 7%, further increases in the inflation rate have a smaller, but still sizeable negative effect on popularity. However, for inflation rates larger than 10%, higher inflation rates do not further erode presidential popularity. This result is consistent with the finding of the existence of threshold levels of inflation perception by Dräger, Menz and Fritzsche (2011).

At first sight, one might be surprised that the electorate holds the U.S. president responsible for inflation even though it is primarily the formally government-independent Federal Reserve Bank which is responsible for controlling inflation. However, the voter seems not to (be able to) distinguish between the roles of different governmental institutions. Moreover, the U.S. president has the formal right to nominate the Chairman of the Board of Governors and thus might be held responsible for a suboptimal performance of U.S. monetary policy in controlling inflation.

Unemployment The relationship between unemployment and presidential popularity clearly shows a non-linear pattern.[9] For unemployment rates below a threshold of about 7%, the effect of increasing unemployment is almost zero or at least very small.

[9] Again, this basic finding coincides with the study by Carlsen (2000).

Voters do not care about the exact unemployment rate as long as it is low. However, when the unemployment rate exceeds this critical value, increased unemployment has a strong negative impact on presidential popularity. While a 3-point increase in the unemployment rate from 4% to 7% reduces popularity by only 3 points, a similar increase from 7% to 10% costs roughly 14 points of support. Unemployment rates exceeding 7% were reported in 118 of 603 months in our sample, mainly during the presidencies of Ford, Carter, Reagan and George H. W. Bush.

Government Consumption While inflation and unemployment have quite regularly been included in studies on the determinants of presidential popularity, much less evidence is available on the voters' perceptions of fiscal measures. When using government consumption (not including defense expenditures) as a proxy for a government's fiscal activity, we find a significantly negative but linear effect on popularity. Thus, U.S. voters in general seem (ceteris paribus) not to be interested in fiscal stabilization programs. This result is in line with recent findings by Brender and Drazen (2008), who show that loose fiscal policies are generally associated with lower re-election probabilities. However, one might suspect that the voters' perceptions of stabilization programs might depend on the overall state of the economy. We will return to this aspect in the next section where we allow for interaction effects between the three economic variables.

Time in Office As discussed earlier, several hypotheses about the development of presidential approval over the term of office have been tested in previous empirical studies (costs of ruling, honeymoon, and nostalgia effects). All these hypotheses are quite controversial in the literature since the empirical results depend very much on the method by which the expected pattern is modeled (typically by time-varying dummy variables). Our approach of modeling time effects via a time-in-office variable and allowing for a non-linear relationship avoids this sort of issue and is thus useful to shed light on the factual existence of these effects.

Interestingly, our results indicate that all three mentioned effects in fact exist. In general, presidential popularity tends to decrease over a president's first term of office. This finding is in line with the cost-of-ruling argument. As predicted by the honeymoon hypothesis, presidents (ceteris paribus) have their highest approval ratings in the beginning of their first term. Finally, we also find evidence in favor of the nostalgia effect. During the last year of the electoral term, popularity tends to increase again (at least slightly). However, as is well known from the literature on political budget cycles, this effect might result from incentives to implement favorable but costly policies to improve president's short-term re-election chances.

Remarkably, the popularity pattern of presidents in their second term of office shows a similar pattern to the first. Again, presidential popularity turns out to be maximal throughout the first months of the (additional) term of office, although the popularity level turns out to be much lower than in the first period. As time goes by, presidential popularity again erodes (although to a much lesser extent), but recovers roughly one-and-a-half years before the second term of office ends. The fact that a recovery of popularity occurs at the end of the final term of office might be taken as an indication that this effect is not primarily driven by re-election concerns. In particular, presidents in their second term of office seem to profit from a strong nostalgia effect.

War Casualties Since World War II, the U.S. has been involved in three major wars of considerable length: Vietnam, Iraq, and Afghanistan. While short external conflicts are well known to cause a rally-around-the-flag effect that boosts presidential popularity, the effect of longer-lasting conflicts is dependent on the public's perception of the conflict. One might expect this perception to be related to the number of U.S. soldiers killed in action. Especially for the Vietnam War, we find a strong negative impact of casualty figures on presidential approval. The detected non-linearity indicates some sort of adaptation effect. At a certain stage, voters seem not to distinguish between "high" and "very high" monthly casualty figures.

Obviously, the monthly casualty numbers in Afghanistan and Iraq were much lower. It is, thus, not surprising that we do not find adaptation effects for these wars. Moreover, no significant effect of casualty numbers is found for the Iraq war. Since both wars overlap since 2003 the latter finding might be explained by a common perception of casualties in the War on Terror.

Summing up, we might conclude that there is strong evidence that the state of the economy has significant and non-linear effects on presidential popularity after controlling for the effects of political events. While the effect of government consumption turns out to be linear, unemployment and inflation seem to exert a strongly non-linear effect on presidential popularity. As a consequence, the results of linear estimation approaches strongly depend on the choice of the sample period. In times of modest unemployment rates, linear estimation techniques will likely deliver insignificant effects of unemployment on government popularity while significantly negative effects are likely to result in times of unemployment rates above 7%. We also find non-linear effects of a presidents' time in office, thereby delivering supporting evidence for the honeymoon, nostalgia and cost-of-ruling hypotheses. Finally, we find negative effects of war casualties on presidential approval for the wars in Vietnam and Afghanistan. However, in the case of the

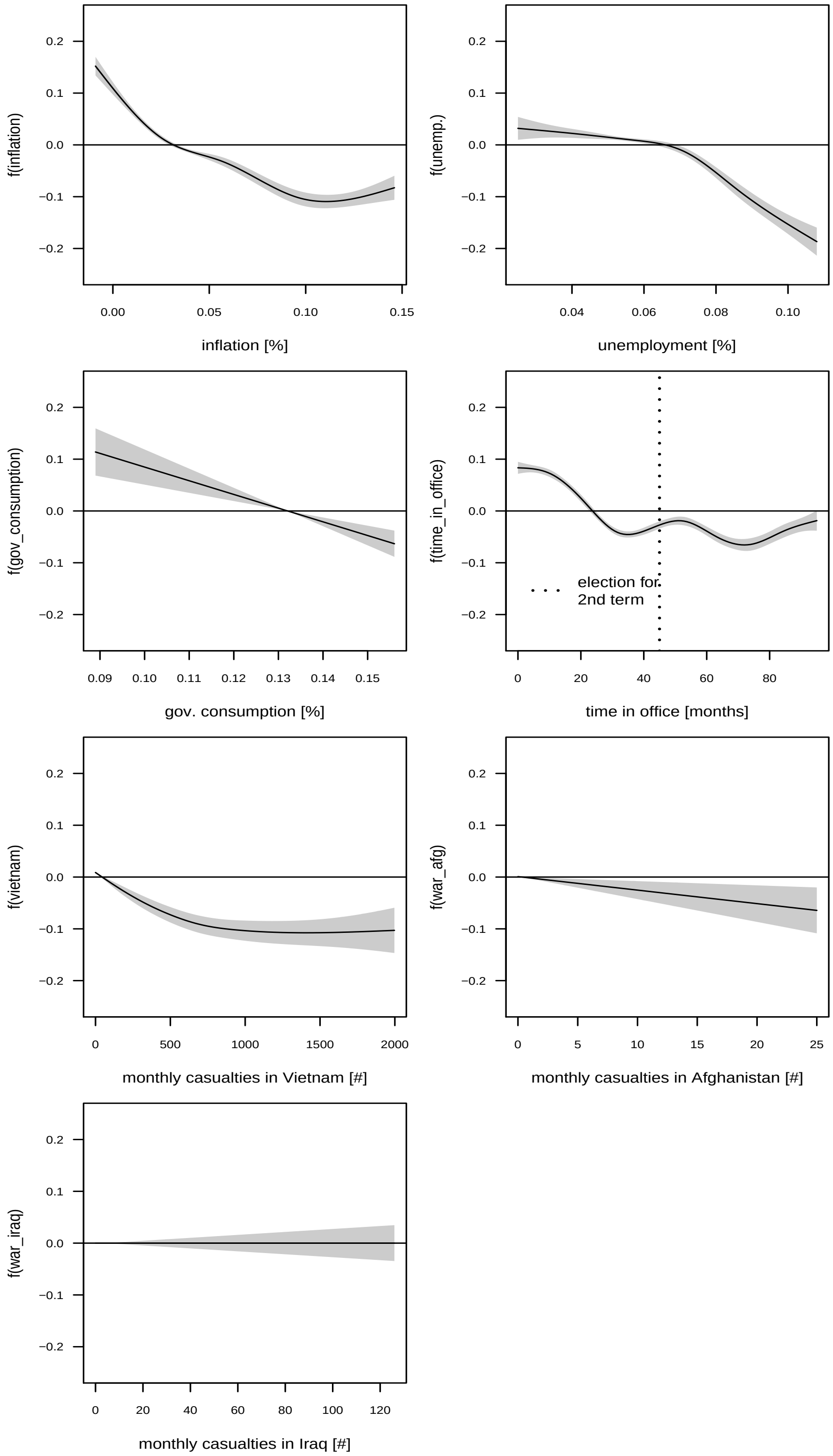

FIGURE 1 Fitted smooth effects of model (7) with 95% point-wise confidence intervals.

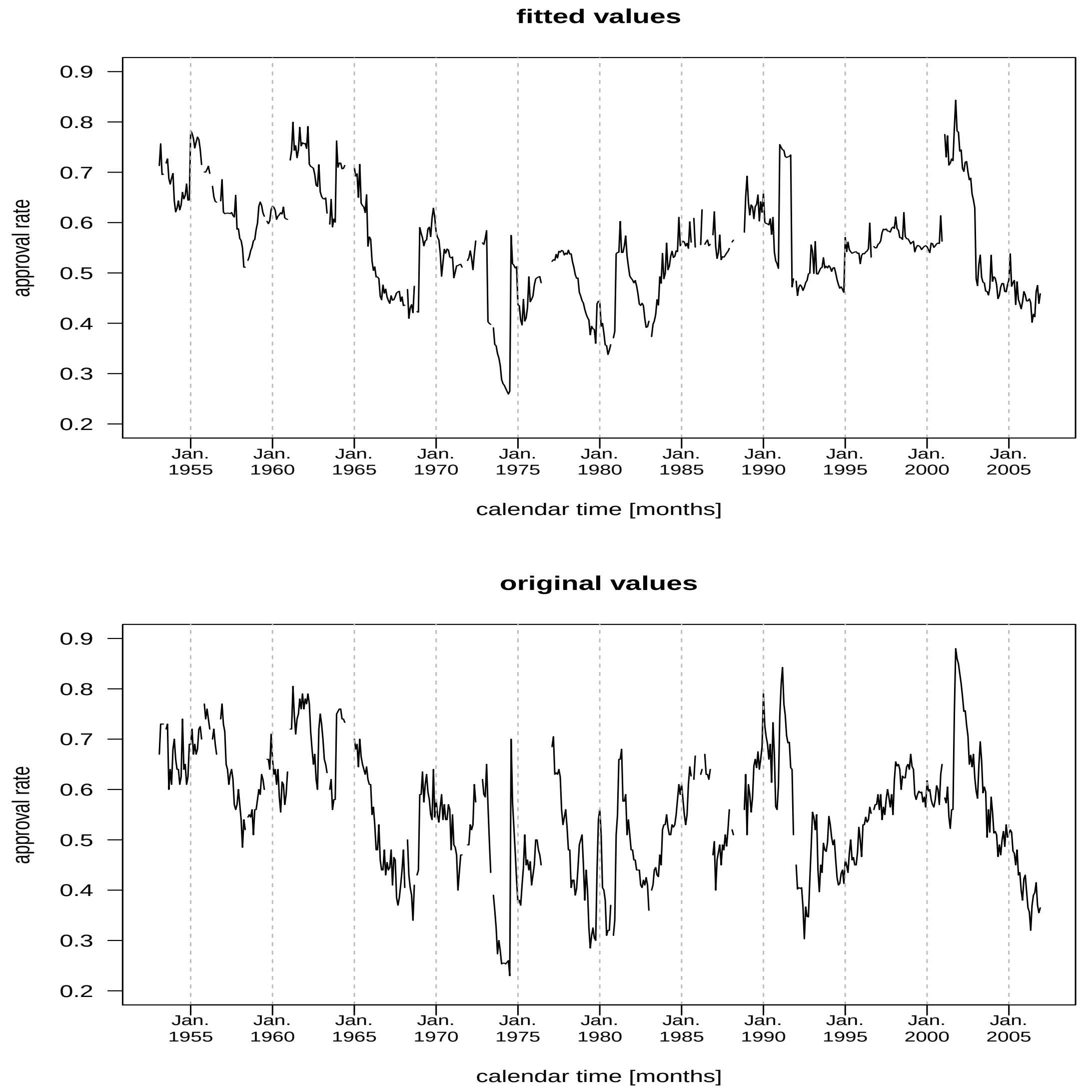

FIGURE 2 Fitted and original values of model (7).

Vietnam war the detrimental effect of casualty figures on popularity seems to decrease with increased levels of the death toll.

In Figure 2, we show a comparison of the popularity time series and the fitted values. It appears that our estimation approach delivers a good fit for the time series to be explained.

6 Interaction Models

In the previously employed estimation approach, we assumed additive effects of economic variables on presidential popularity. In reality, however, this assumption does not necessarily hold true. The existence of interaction effects between the considered economic variables is quite likely but is a yet unexplored field of research.

In order to study the existence and relevance of interaction effects, we relax the restriction of separate effects of the economic variables on presidential popularity in the following. More precisely, we allow for non-linear interaction effects between the economic variables while leaving the rest of model structure unchanged. The model to be estimated is then given by

$$\begin{aligned} approval_i &= \beta_0 + f_{1,2,3}(inflation_i, unemployment_i, gov.consumption_i) \\ &+ f_4(time.in.office_i) \\ &+ f_5(vietnam.casualties_i) \\ &+ f_6(afghanistan.casualties_i) \\ &+ f_7(iraq.casualties_i) \\ &+ X\beta + t_{io} + \epsilon_i, \end{aligned} \tag{8}$$

with $f_{1,2,3}(\cdot)$ being a smooth but a-priori unspecified function of three metrically scaled covariates. The assumption of additivity is therefore eased for the effects of these economic covariates. With respect to the assumptions of the functional form, model (8) therefore takes a position between models (2) and (3) with respect to a-priori assumptions on the functional form.

The common technique of estimating interaction effects in classical OLS models by creating products of the underlying data vectors can be transformed to obtain a new basis function and a resulting $\hat{f}_{1|2|3}(\cdot)$. The tensor product basis matrix used to obtain the latter is gained by determining all possible interactions of the high-dimensional univariate spline basis for z_1, z_2, and z_3. By following the notation of Wood (2006), the latter can be achieved by using the Kronecker products

$$\tilde{B}_r \;=\; B(z_1)_r \otimes B(z_2)_r \otimes B(z_3)_r \tag{9}$$

to obtain the r-th row of the new, joint basis representation for the three metrically scalaed covariables z_1, z_2, and z_3. The smoothing technique, employing penalized splines, is therefore built upon this joint high-dimensional tensor products. With the latter, model (6) changes to

$$y_i \;=\; \beta_0 + \tilde{B}(z_1, z_2, z_3)\tilde{b} + \sum_{j=3}^{q} B_j(z_j)b_j + \sum_{u=1}^{p} x_u\beta_u + t_{i0} + \epsilon_i, \tag{10}$$

with $\tilde{b}$ being the corresponding (random) coefficient vector. Note, that the latter is still a LMM with the resulting inference techniques, as being described in Section 3. For consistency, $\tilde{B}(\cdot)$ is again constructed by employing cubic smoothing splines. Note that

$$\sum f_{1,2,3}(z_{i1}, z_{i2}, z_{i3}) \;=\; 0 \tag{11}$$

additionally guarantees the identifiability of the new model (see Fahrmeir et al. (2009) for details).

While an interaction of two metrically scaled covariates can be visualized by so-called *interaction surfaces*, a graphical analysis of a three-dimensional function leading to a four-dimensional visualization is not straightforward. However, by holding one of the three covariates of the joint effect constant at well-defined values, the joint effect can be visualized by an array of interaction surfaces. For numerical and graphical details, see Wood (2011). The estimation of the necessary variance components can again be carried out with REML estimation technique.

Again, we begin by discussing the estimation results with the parametric effects displayed in Table 4. The effects of the major events remain qualitatively unchanged. However, the effect of 9/11 is now even more pronounced. The estimation results for political events change only slightly. The only remarkable difference is that negative personal events now deliver a plausible and significantly negative coefficient. The effect of divided governments remains significant, but is now numerically smaller.

In a next step, we turn to the various non-economic variables for which we allow non-linear effects (see Figure 3). The time-in-office variable behaves quite similar to the non-interaction case. However, the effects in the second term of office are now more pronounced than before. In general, the war variables are unaffected though the Afghanistan casualties tend to have a smaller effect, close to being insignificant.

In Figure 4, we show a visualization of the interaction effects between the economic variables. We decided to show the interaction effects between unemployment and government consumption as an interaction surface for various levels of inflation. For the sake of clarity, statistical significance is not displayed in Figure 4. For all five displayed

TABLE 4
PARAMETRIC ESTIMATION RESULTS OF MODEL (8)

covariate	$\hat{\beta}_j$	p-value
(Intercept)	0.57	< 0.01
watergate	-0.19	< 0.01
desert.storm	0.19	< 0.01
nine.eleven	0.16	< 0.01
neg.domestic	-0.02	0.04
neg.foreign	-0.01	0.75
neg.personal	-0.04	< 0.01
pos.domestic	0.06	< 0.01
pos.foreign	0.05	< 0.01
pos.diplomatic	0.02	0.07
pos.personal	0.03	0.07
divided.gov	0.09	< 0.01
Eisenhower	-0.29	< 0.01
Kennedy	-0.14	< 0.01
Johnson	-0.08	0.03
Nixon	-0.03	0.18
Ford	-0.05	0.23
Carter	-0.04	0.14
Reagan	0.04	0.17
BushSr	0.006	0.78
BushJr	-0.04	0.13
$Var(\hat{t}_{i0})$	0.004	–

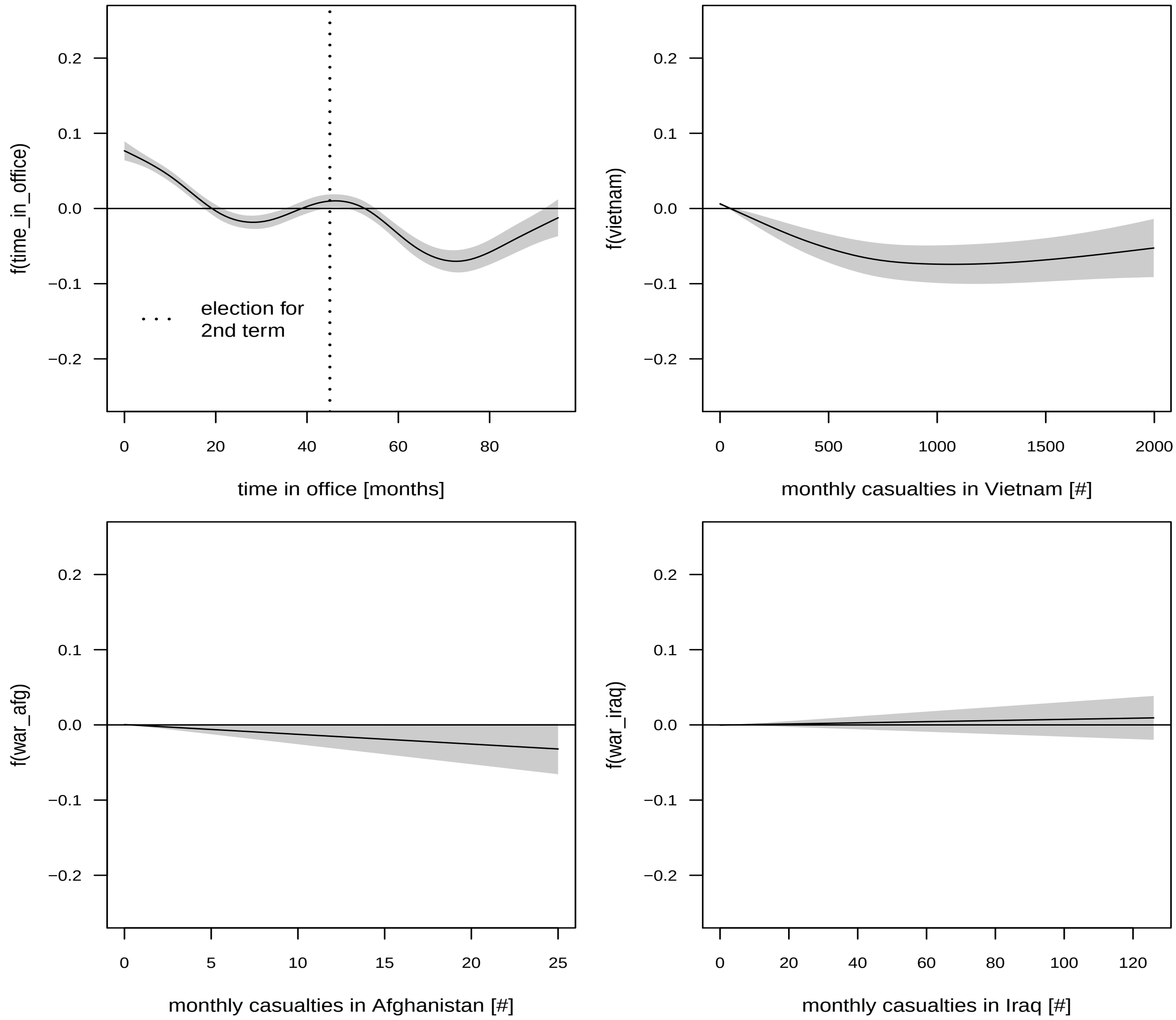

FIGURE 3 Additional fitted smooth effects of model (8) with 95% point-wise confidence intervals.

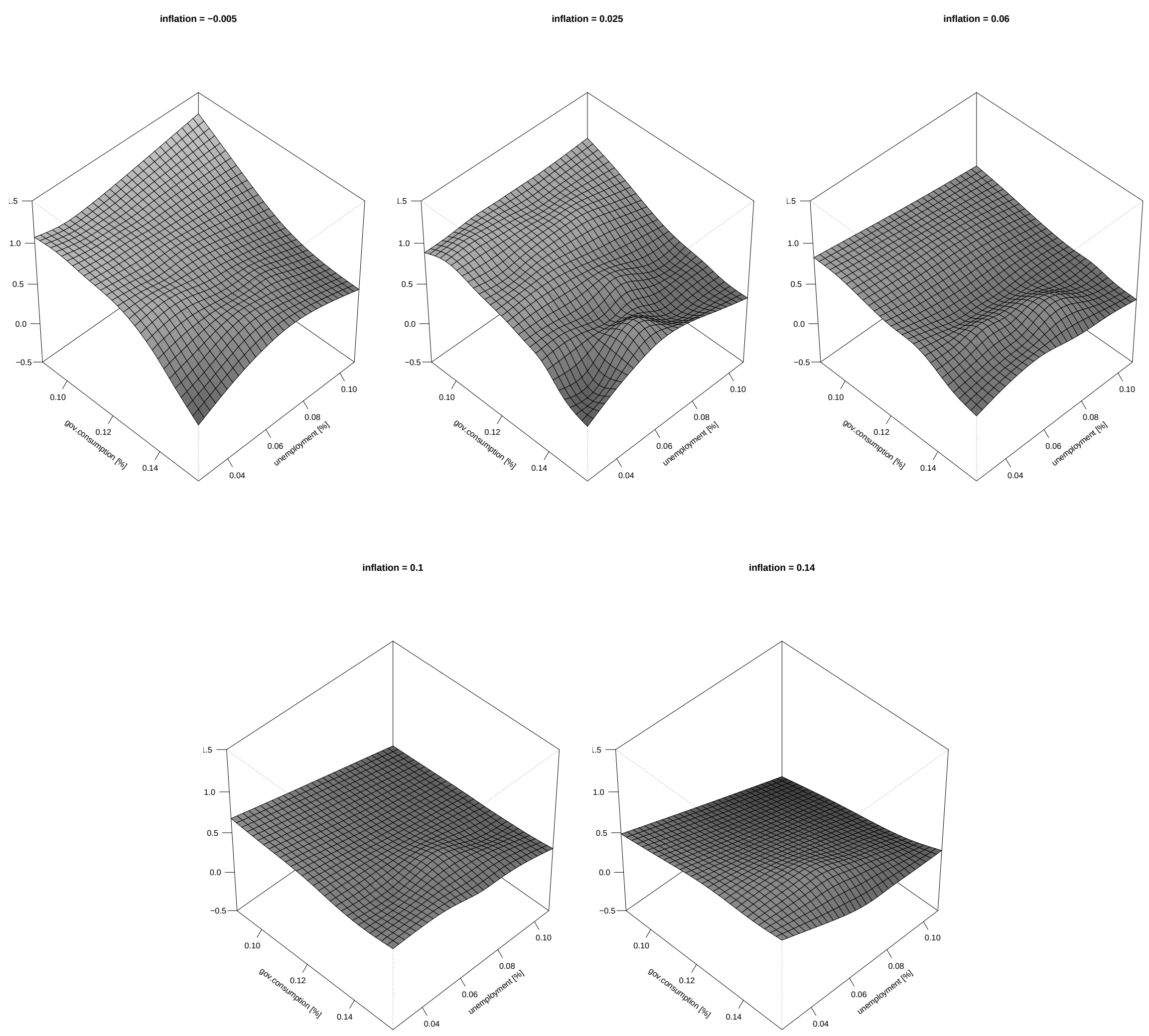

FIGURE 4 Fitted smooth interaction effects of inflation, unemployment, and government consumption in model (8), holding inflation constant for selected values.

interaction surfaces one should be cautious in interpreting the results at extreme values, as statistical significance can not be guaranteed with a low number of observations.

We start out interpreting Figure 4 by focusing on the case of very low inflation rates (or moderate deflation). In times of very low inflation, increasing government consumption for almost any given rate of unemployment is harmful for the president. When unemployment is very low, increasing government consumption leads to particularly strong decreases in popularity. One might suspect this to be due to the feeling that government spending programs are unnecessary during times of high employment. In times of high unemployment, voters do not punish increased spending as soon as a spending level of roughly 12% is reached.

When moving to higher but still moderate inflation regimes (2.5%, 6%), the basic picture remains similar, but the described effects flatten significantly. In general, the interaction surface tends to tilt backward relative to the imaginary axis between low government consumption and high unemployment. High government consumption at low levels of unemployment becomes less problematic, while low government consumption at high levels of unemployment is now perceived to be worse than before.

Interestingly, in times of high inflation, the situation is reversed completely. Under high inflation, increased spending is no longer perceived as an evil. While government spending increases popularity only slightly in times of low unemployment, spending programs tend to be quite popular under high-unemployment regimes.

The question of why rising inflation has such a strong effect on the perception of government spending programs under varying labor market conditions is intriguing. Often, spending programs are financed via deficit spending. Excessive deficits contribute to a high level of public debt. However, in times of high inflation, the public deficit erodes quickly in real terms at the burden of domestic and foreign creditors. This is especially true when large parts of the public deficit are not indexed, such as in the United States.[10] Thus, voters might find the financing burden of spending programs less problematic in periods of high inflation. Particularly in times of high unemployment, presidents may thus profit from an increase in government consumption figures.

[10]As Aizenman and Marion (2009) argue, the U.S. government might have a strong incentive to inflate away the burden of the enormously risen public debt as a consequence of the recent financial crisis.

TABLE 5
MODEL SELECTION CRITERIA

	model (7)	model (8)
AIC	-1493.51	-1649.96
BIC	-1319.13	-1461.08

While the presented findings point in the direction that the interaction effects between economic variables are important and that taking them into account is inevitable, it seems necessary to compare both presented modeling approaches with respect to econometric criteria. As shown in Figure 5, the model fit of the interaction model is even better than that of the additive model. The models can be compared on the basis of the AIC and BIC criteria.[11] As depicted in Table 5, both criteria clearly favor model (8).

7 Conclusions

In this paper, we estimate popularity functions for the United States using a modern semi-parametric estimation approach. We deviate from the existing literature by not assuming any specific (and arbitrarily chosen) functional form, but allowing for a more data-driven and a-priori unspecified linkage between presidential approval and its likely determinants. Our results indicate that the most commonly used linearity assumption is inconsistent with the rather complex relationship between the presidential approval rate and its determinants. The shortcoming of allowing for non-linearities might have contributed to the fact that "in spite of considerable efforts very little is 'cut and dried' in this field, and again and again discussions flare up when this or that result

[11]For a detailed discussion of the employed AIC and BIC measures and their corresponding definitions in the context of non-parametric estimation techniques, see Wood (2006) and Fahrmeir et al. (2009).

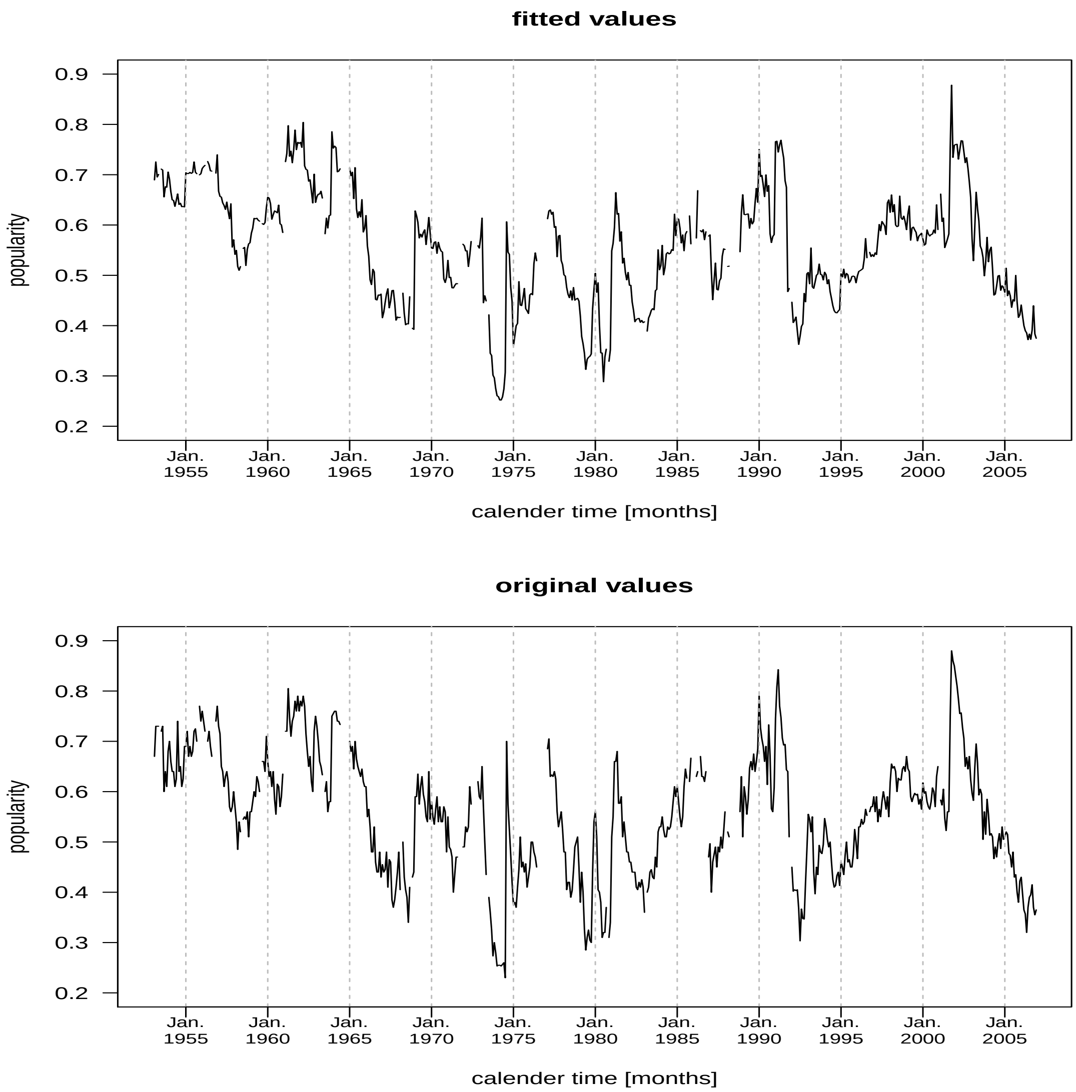

FIGURE 5 Fitted and original values of model (8).

is found to be lacking in stability" (Paldam 1991). The use of non-linear estimation techniques might therefore contribute much to deepening the understanding of the true determinants of presidential popularity.

We do not only find strong evidence for non-linearities in the relationship between economic variables and presidential popularity. We also show that strong interaction effects between these economic variables seem to exist. It is thus not useful to rely on purely additive (or even linear) effects when trying to uncover the determinants of presidential approval. Whenever these interaction effects exist, the perception of certain policies strongly depends on the macroeconomic situation. Presidents caring about their popularity among voters will have to take these effects into account when deciding on their policy measures. For example, spending programs might be perceived very differently under varying inflationary and employment regimes.

We also find strong evidence for the hypothesis that presidential approval rates, on average, follow a typical time pattern. While the literature up to now has operated with quite specific assumptions about the exact form of this pattern, our non-parametric approach allows us to model time in office as a possibly non-linear effect and is thus compatible with any possible time pattern. In general, we find presidential popularity to decrease over the term of office, which is in line with the cost-of-ruling argument. Moreover, we find supporting evidence for the hypotheses of a honeymoon and a nostalgia effect.

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