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Measuring Political Budget Cycles:
A Bayesian Semiparametric Assessment

Masahiro Tanaka

Waseda INstitute of Political EConomy
Waseda University
Tokyo,Japan

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Abstract

In this paper, we estimate the effects of political variables, including the government's popularity (approval rate) and term in office (tenure), on fiscal variables without any assumption of functional form, using a Bayesian semiparametric regression technique and US data. Our main findings are twofold. First, the effects of term in office are not statistically significant; that is, we find no evidence of either an unconditional or popularity-conditional political budget cycle. Second, the effects of the presidential approval rate on government consumption are U-shaped. This implies that the incumbent has an incentive to reduce government spending when the race for office is neck-and-neck, while the budget can be loosened when the incumbent is either certain to win or certain to lose the next election. The functional form of these effects is invariant throughout tenure. The estimation results indicate that incumbent politicians have an incentive to reduce federal government consumption to signal their competence to voters who are fiscally conservative, and that the political incentive to manipulate fiscal policy arises not only immediately before elections but also throughout the term of office.

1 Introduction

Fiscal policy is a consequence of politics, with political economists paying close attention to the effects of politics on fiscal policy and the resulting impact on the business cycle. One conventional hypothesis extensively examined thus far is that politicians opportunistically increase gov-

*Waseda University, Graduate School of Economics, Research Fellow of Japan Society for the Promotion of Science. I would like to thank Hideki Konishi for his many suggestions and guidance and Kozo Ueda for helpful comments.
Email: gspddlnit@toki.waseda.jp

ernment expenditure immediately before elections to please voters and increase the probability of re-election: that is, a political budget cycle. However, although this body of research has a long history dating back at least to Nordhaus's (1975) pioneering work on political business cycles, there is no consensus finding [1].

Problematically, the core of the controversy remains the context conditionality of political budget cycles. Many recent empirical studies find that political budget cycles emerge only in developing countries, young democracies, or countries with less transparent budgetary processes and so on[2]. While most of the conditions do not apply to developed countries with established democracies, conditionality on re-election probabilities, or the government's popularity, is a notable exception because of the substantial published empirical evidence concerning developed countries.

Among the existing literature, however, the estimated functional forms of the effects are very different. For instance, Frey and Schneider (1978) find that the US federal budget is likely to expand before elections if the presidential approval rate is low; i.e., political budget cycles are monotonically conditional on government popularity. Schultz (1995) confirms this result using UK data, whereas Price (1998) argues that the functional effect of the approval rate on fiscal policy is not monotonic but rather an inverted U-shape. This implies that political budget cycles tend to be more evident when the electoral competition is neck-and-neck, while the cycle rarely appears when the incumbent is likely either to win or to lose the next election. Price (1998) hypothesises that because the manipulation of fiscal policy is costly, the engineering of political budget cycles only pays off when the marginal gain is high, i.e., the incumbent is close to victory.

Subsequent empirical studies provide mixed evidence on this point. Some identify a monotonic relationship between the probability of re-election and the manipulation of fiscal policy, e.g., Pettersson-Lidbom (2001) for Swedish municipalities, Aidt et al. (2011) for Portuguese municipalities, and Fiva and Natvik (2013) for Norwegian municipalities, while others conclude an inverted U-shaped relationship, e.g., Alt and Rose (2009) for US states and Efthyvoulou (2012) for EU-27 countries. Moreover, Schneider (2010) find no statistically significant relationship for German municipalities.

[1] Initially, political economists sought to identify the political manipulation of macroeconomy via fiscal and monetary policy. After failing to identify robust evidence, the research agenda has shifted to the political budget cycle. Drazen (2001) reviews this voluminous literature.

[2] For example, Shi and Svensson (2003); Brender and Drazen (2005); Alt and Lassen (2006a). See de Haan and Klomp (2013) for a review of this line of research.

The present paper investigates the effects of political variables, including the approval rate and the term in office (or tenure) of the president, on the US federal budget to examine the unconditional and popularity-conditional political budget cycles. We provide three major departures from conventional analysis in this area. First, we estimate the functional effects of the political variables on the fiscal variables without any assumption concerning the functional form using a semiparametric method known as Bayesian P-splines (Lang and Brezger (2004); Wiesenfarth et al. (2014)). To our best knowledge, this is the first study to apply a nonparametric method to this strand of the literature. Second, we separately estimate the empirical model for the subcomponents of the federal budget and two major tax rates: government consumption, transfers, and investment; and labour and capital income taxes. This echoes the recent findings that political budget cycles are confined to subcomponents of the budget, e.g., Katsimi and Sarantides (2012); Enkelmann and Leibrecht (2013). Statistically, we identify significant results only for government consumption. Lastly, our empirical model includes lags between the fiscal and political variables. This reflects the findings of recent macroeconomic studies that emphasise the importance of the anticipation of fiscal policy. With budgetary processes and implementation lags, private agents can anticipate government expenditures and changes in the tax code beforehand and respond to fiscal news rather than to realised fiscal changes.

The main findings are as follows. First, the effects of the term in office for the president are not statistically significant for all fiscal variables. Second, the estimated functional effects of the approval rate on government consumption are U-shaped. This implies that the incumbent has an incentive to reduce government consumption when the race for the office is neck-and-neck, while the budget becomes looser when the government is either certain to win or certain to lose the next election. Finally, the estimated functional effects based on a specification with the interaction between the approval rate and term in office imply that the incentive to manipulate fiscal policy is invariant during tenure. That is to say, while the US president's popularity certainly affects the budget, there is no evidence of either an unconditional or popularity-conditional political budget cycle. This conclusion is robust with respect to a number of changes to our model specification.

The estimated nonmonotonic relationship between popularity and government consumption that we identify can be interpreted through the lens of Martinez's (2009) theoretical argument and his political career concerns model. In his model, a politician's incentive to signal his competence to voters by making a costly effort is an inverted U-shape: that is, the greater the voter's belief that the incumbent's competence is close to that of the average potential candidate, the greater the government's incentive to make an effort. In other words, as the race for office becomes neck-and-neck, the incumbent is more likely to make an effort. As for the politician's costly effort, Martinez (2009) deals with public goods production at the cost of less rent extraction. As with Martinez (2009), other studies examining the conventional hypothesis of political budget cycles operate on the premise that voters favour increases in government spending. However, some empirical studies suggest the opposite, i.e., that US voters are fiscal conservatives; for instance, Peltzman (1992); Berlemann et al. (2014) [3]. Combining these theories and factual observations, we interpret the empirical findings of our paper as meaning that incumbent politicians use the reduction in federal government consumption as a signalling device.

The remainder of the paper is structured as follows. Section 2 describes the empirical framework. Section 3 reports the estimation results. Section 4 discusses these results. Section 5 investigates the robustness of the baseline results. Section 6 concludes. The technical details and estimation results for the alternative specifications are contained in the Supplementary Material.

2 Empirical Framework

2.1 Model

We estimate separate econometric models for the subcomponents of the US federal budget and major tax rates: government consumption, investment, and transfers; and labour and capital income taxes. This echoes recent findings that political budget cycles are confined to subcomponents of the budget, e.g., Katsimi and Sarantides (2012); Enkelmann and Leibrecht (2013). Because the estimated effects of the political covariates are not statistically significant for any fiscal variables other than government consumption, the remainder of the analysis mainly focuses on government consumption.

A baseline model for government consumption ($GovCons$) is specified as follows:

$$GovCons_t = \phi + \rho GovCons_{t-1} + f_1\left(Term_{t-4}\right) + f_2\left(Appr_{t-4}\right) + \varepsilon_t, \tag{1}$$

where ϕ is a constant term, ρ is an autocorrelation parameter, ε_t is an error term, and $f_i\left(\right), i = 1,2$

[3] Alesina et al. (1998); Brender and Drazen (2008) provide supportive evidence on this argument using international panel data.

are unknown smooth functions. $Term = 1, 2, ..., 16$ denotes the president's term in office, being the number of quarters from the last election (tenure begins with $Term = 1$, and given four-year terms of office, the next election is held when $Term = 16$). $Appr$ is the presidential approval rate in the last poll in each quarter, conducted by Gallup Poll. While congressional representatives of course play an important role in fiscal policy, the president has a critical influence on the budgetary process. On this basis, we concentrate on presidential approval as per the extant literature on the US political budget cycle.

We specify four-quarter lags for the covariates to capture implementation lags in the government budget. Lags arise when the political incentive to manipulate actual fiscal policy materialises as a change in planned expenditure or changes in the tax code. As a result, private agents can anticipate changes in government expenditure or the tax code before their realisation. The recent macroeconomic literature emphasises the importance of fiscal news in the context of private agents' information and ultimately macroeconomic volatility. For instance, Schmitt-Grohé and Uribe (2012) estimate a micro-founded macroeconomic model and report that two-thirds of the variation in output in response to fiscal policy is attributable to exogenous shocks anticipated at least four quarters before their realisation, which implies that private agents respond mainly to fiscal news, not realised fiscal changes[4].

We introduce time lags between the political and fiscal variables for the following reasons. As a politician is supposed to manipulate fiscal policy to demonstrate competence, there is no need for manipulated fiscal policy to be realised before the election. From a theoretical point of view, what is crucial is not what fiscal policy materialises, but what a politician displays to voters. Given that fiscal news is not directly observable, some studies collect official documents and construct a narrative measure of fiscal news regarding government expenditure and changes in the tax code, e.g., Ramey and Shapiro (1998); Ramey (2011). However, the announcement of future policy changes precedes the evolution of the opportunistic incentives to manipulate. In addition, expenditure coverage is mainly restricted to defence spending. Therefore, this kind of measure is not suitable for the present analysis. At the same time, manipulated fiscal policy must materialise at least on average, otherwise voters would be continuously deceived by the government. For these reasons, the specification of time lags is preferable.

Of course, the choice of lag length is not a trivial task. Indeed, the implementation of fiscal

[4]See also Yang (2005); Leeper et al. (2012); Born et al. (2013) for related studies.

policy spans the entire budget year and sometimes extends over several years, and there is also scope to compile additional budgets on an occasional basis. Consequently, it is difficult to pin down a specific time period where the political incentive to manipulate fiscal policy presents itself. We justify a lag length of four quarters in that it corresponds to the time lag between the release of the Annual Budget Message to the Congress and the beginning of the fiscal year. As shown later, the conclusion is robust to alternative lag length specifications.

2.2 Data and inference

All the data are quarterly and span the period 1953Q1:2012Q4, i.e., from Eisenhower to Obama's first term. See Appendix A for details of the data construction. Most variables include their own trends, but we require stationarised data because our primary interest is the cyclical dynamics, and because the estimation of the model requires the centring the functions around zero to avoid any problems with identification. The cyclical component is constructed using the one-sided Hodrick–Prescott filter (Stock and Watson (1999)) and measured as percentage deviations from the trend. We conduct the estimation using the Bayesian P-Spline regression method developed by Lang and Brezger (2004). See Appendix B for a more detailed overview of the methodology and the technical details.

3 Results

3.1 Baseline results

Column 1 in Table 1 presents the parametric estimates for government consumption[5]. The high autocorrelation shown for government consumption is in line with the findings of the existing literature. Figure 1 depicts the nonparametric estimates of the functional effects of the presidential term and approval rate on government consumption, specifically the predicted values of $f_1(Term_{t-4})$ and $f_2(Appr_{t-4})$ in equation (1) [6]. The shaded areas portray the 90 and 95% pointwise credible intervals.

The effects of presidential term are not statistically significant for the entire range. Therefore,

[5]Supplementary Material, S.3.7 presents examples of the resutls for other fiscal variables.

[6]Because of identification issues such that the estimated functional effects are centred around zero, it is not possible to interpret their absolute values (the vertical axis). A companion paper, Tanaka (ming), quantitatively investigates the effects of political variables on the US federal budget and macroeconomic volatility.

we find no unconditional political budget cycle in the sample. The estimated functional effects of the presidential approval rate on government consumption exhibit a U-shaped (or V-shaped) form. The trough of the estimated effects is at about a 45% approval rate, and the estimated functional effects are statistically significantly different from the average level under 30% and between 75–80%. In other words, when electoral competition is tighter, the government has an incentive to decrease government consumption, while when the incumbent is either certain to win or certain to lose the next election, the budget loosens. The result implies that when the incumbent is close to electoral victory, he has an incentive to signal competence by making an effort to reduce expenditure.

3.2 Interaction between presidential approval rate and term in office

To investigate the existence of popularity-conditional political budget cycles, we examine the interactions between the presidential approval rate and the term in office by estimating two-dimensional functional effects of both these covariates. We modify the baseline model to

$$GovCons_t = \phi + \rho GovCons_{t-1} + f\left(Term_{t-4}, Appr_{t-4}\right) + \varepsilon_t,$$

where $f()$ is a generic two-dimensional smooth function and the rest of the notation is the same as in the baseline case. See Supplementary Material S.2.1 for details of the inference.

Column 3 in Table 1 and Figure 2 present the estimation results. As shown, the estimated functional effects of the approval rate remain U-shaped, being invariant to the term in office, while the estimated functional effects are not statistically significant everywhere because of the small sample. The estimated functional effects of presidential term are slightly increasing, in particular in the final stretch of the term of office, but their magnitude is smaller than the effects of the approval rate. Therefore, the estimated interactions between the presidential term and approval rate are not significant, and we find no popularity-conditional political budget cycle, nor any unconditional counterpart.

4 Discussion

This section discusses the estimation results in light of Martinez's (2009) political career concerns model à la Holmström (1999). His model is a suitable platform for the purpose because it delivers a theoretical foundation for both the conditionality of political budget cycles on the incumbent's re-election probability, and the dynamics of the opportunistic incentive to manipulate policy within the period of tenure.

4.1 U-shaped relationship between popularity and government consumption

In terms of the intratemporal incentive structure, the estimated U-shaped relationship between the approval rate and government consumption is consistent with Martinez's (2009) model if we believe US voters are fiscally conservative. In his model, the closer voters' beliefs about the incumbent's competence are to their prior beliefs, the greater the incumbent's incentive to make a costly effort, implying that the functional relationship between belief, or popularity, and the effort level is an inverted U-shape. While Martinez (2009) specifies a politician's effort as public goods production at the cost of less rent extraction, his argument does not hinge on this assumption. Therefore, as long as voters value reduced government consumption, the estimation result is in line with his theoretical model.

While the traditional hypothesis of political budget cycles supposes that voters favour increases in the government budget, some empirical studies present the opposing view, especially for the US and other developed countries. For example, Peltzman (1992) finds that in the US, increases in government spending are associated with losses in the incumbent party's vote share in both federal and gubernatorial elections. For 19 OECD countries, Alesina et al. (1998) show that cabinets that force through painful fiscal adjustments do not lose popularity or face a reduced probability of re-election, especially if the fiscal adjustment is based on cuts in current spending. Brender and Drazen (2008); Buti et al. (2010); Enkelmann and Leibrecht (2013) provide further evidence on this line of argument based on extensive international panel data of fiscal policy and election results. Brender (2003); Drazen and Eslava (2010) make a similar point for local elections in Israel and Columbia, respectively. In addition, Berlemann et al. (2014) show that increases in government consumption (excluding defence spending) lower the US presidential approval rate[7]. Because the reduction in government expenditure incurs some political costs for the incumbents, it can work as signalling instrument, not merely cheap talk.

There is mixed evidence on popularity-conditional political budget cycles. Some studies, e.g.,

[7]In a similar vein, the first equation in the two-stage estimation (see the robustness check below) shows that as government debt accumulates, the president loses popularity (Supplementary Material, Figure 21 (d)).

Price (1998); Alt and Rose (2009); Efthyvoulou (2012), report nonmonotonic relationships between re-election probabilities and government budgets for the UK, US states and EU-27 countries, but the signs of the effects they identify differ from the current analysis, such that the tighter the electoral competition, the more fiscal policy becomes expansionary. Other studies show that the relationship between re-election probabilities and incentives to manipulate the budget are monotonic using data from various countries, e.g., Frey and Schneider (1978); Schultz (1995); Pettersson-Lidbom (2001); Aidt et al. (2011); Fiva and Natvik (2013). Finally, Schneider (2010) find no significant relationship for the West German states.

Hanusch and Magleby (2014) argue that this mixed evidence on popularity-conditional political budget cycles can be attributed to differences in party polarisation among countries. For example, in highly polarised countries such as Sweden (Pettersson-Lidbom (2001)) the relationship is monotonic, while in unpolarised countries such as the UK (Price (1998)) it is nonmonotonic. Under a highly polarised party system, preferences over the composition of the budget are diverse, so if the incumbent is unlikely to win the next election, political budget cycles emerge as a strategic use of deficits (Alesina and Tabellini (1990)), with governments conducting their ideologically preferred fiscal policy and leaving any deficits to their successor. As a consequence, the resulting functional effects of popularity on deficits are monotonically decreasing. By contrast, under a relatively unpolarised party system, political budget cycles arise as signalling behaviour aimed at achieving re-election, which is more effective when the race for the office is neck-and-neck, resulting in a nonmonotonic relationship between the probability of re-election and the incentive for policy manipulation.

However, in light of Hanusch and Magleby (2014), the U-shaped functional effects identified here are somewhat puzzling because the US is considered one of the world's most ideologically polarised countries (e.g., Beck et al. (2001)). This point is reconciled by considering that even with a highly polarised party system, US voters are homogeneously fiscally conservative and there is no heterogeneity in preferences over the composition of government consumption. It is natural to regard subcomponents of the federal budget other than government consumption, such as government investment and transfers, as the main arena of any fundamental ideological conflicts or special interest politics. While political budget cycles are likely to appear in highly polarised countries (Alt and Lassen (2006b)), the cycles are rarely found in developed countries where the budget is highly transparent, with informed voters, and in established democracies, e.g., Shi and

Svensson (2003); Brender and Drazen (2005); Alt and Lassen (2006a)[8]. In fact, no statistically significant evidence of political budget cycles in government investment and transfers is found in the sample used in the paper. Therefore, we can interpret the finding here as suggesting that in the US, while a political budget cycle in the traditional sense is not evident, another form of political influence on fiscal policy does arise: namely, the reduction in government consumption as a signalling device.

The estimated apex is around 45% of the approval rate, lower than the minimum requirement for electoral victory of 50% and the sample average of 54.68%. From the perspective of the Martinez (2009) model, the estimated functional effects reflect the prior distribution of voters' estimates of the abilities of politicians. Thus, the result takes on an interpretation, or supposition, that the prior distribution of the US president's ability (as perceived by voters) is right skewed. This is comparable to the fact that the wage distribution, which should be correlated with productivity, is highly right skewed[9].

4.2 Absence of unconditional and popularity-conditional political budget cycles

In Martinez's (2009) model, a politician's incentive to make a costly effort exists throughout his tenure but continuously increases as the next election approaches. In light of this theoretical argument, the empirical finding in the present paper of neither unconditional nor popularity-conditional political budget cycles has many possible causes other than the small sample. First, a politician may little discount the future. Indeed, an individual president inevitably reaches a term limit, and it is natural to conceive that the presidential discount rate is thus quite high. Meanwhile, if the president's behaviour is heavily influenced by his party's interests, he may act as if he has an infinite horizon. Second, he could receive objective and/or subjective payoffs from higher popularity during his term in office. Third, voters may consider a president's performance based not on just the final stage of the term in office, but rather on the whole term of office. While the literature on political budget cycles assumes voters evaluate the incumbent's performance based on information received immediately before elections (e.g., Rogoff (1990); Shi and Svensson (2003)), some empirical studies cast doubts on this view, e.g., Peltzman (1990, 1992); Panzer and Paredes (1991); Fair (1996). The final possibility is that a politician's reputation suffers from major uncertainty.

[8] see de Haan and Klomp (2013) for a survey of this literature.

[9] See Aidt et al. (2011) for a similar argument.

As the influence of his actions on his approval rate is rather limited, he has a strong incentive to manipulate fiscal policy to maintain a high approval rate, even in the early phase of tenure. Of course, if he starts pandering to voters in the later stages of his tenure, it could be too late to affect the vote[10].

Although not statistically significant, there is a robust finding, at least qualitatively, that the US federal government consumption increases in the 13th to 16th quarters after the last election, that is, the final year of the president's tenure, which dovetails with the traditional hypothesis concerning political budget cycles (Figure 1 (a)). Somewhat surprisingly, the specification including the interaction between the two covariates has a smaller DIC (deviance information criterion) than the baseline specification, which means that introducing interactions between the two covariates improves the fit of the model, even though the additional complexity of the model is aggressively penalised in the calculation of the DIC. This result contradicts Martinez's (2009) model and no existing theoretical model can explain it. Further empirical and theoretical investigations are left for future research.

5 Robustness check

This section checks the robustness of the baseline result by re-estimating the model with various modifications. The estimation results of alternative models are assembled in Supplementary Material S.3, and this subsection touches on the main points.

5.1 Controlling economic situations

First, two economic variables are included to control cyclical movements in fiscal policy driven by factors not directly relevant to a politician's opportunistic incentives. First, the ratio of government debt to real GDP captures the debt stabilisation of public finance. This might be political in some way, but would be in line with voters' preferences, and thus is not driven by opportunistic motives. Second, lagged real GDP per capita in logs (percentage deviations from the trend) controls the response to economic situations. We introduce these covariates into the model through nonparametric and linear functions. All the estimated functional effects and coefficients for business cycles and public finance health are not statistically significant and the baseline result is retained,

[10]The course of an incumbent's reputation should not be extremely uncertain, such that his action has an impact on his reputation and that he has an incentive to do act accordingly.

such that the effects of the term in office are not significant and those of the approval rate are U-shaped[11]. Furthermore, inclusion of these covariates always increases DIC, implying that these extensions always worsen the fit of the baseline model.

5.2 Lag specification

Second, models with alternative lag specifications of two- to six-quarter lags are estimated. The estimated effects of presidential term are consistently insignificant, as in the baseline model[12]. When departing from a specification with four-quarter lags, the estimated effects of the approval rate blur somewhat, the loss of statistical significance is rather limited, and the U-shaped functional form is retained. Therefore, changing lag specification does not change the main account that the baseline model with four-quarter lags conveys.

5.3 Partisan politics

Third, we extend the empirical model by introducing some aspects of partisan politics. For the first exercise, two additional dummies are included: (1) Democrat dummies (if the president is affiliated with the Democratic Party it takes a value of one, otherwise zero), and (2) divided government dummies (if the party affiliations of the president and the largest party in Congress are different it takes a value of one, otherwise zero). The former captures partisan differences in preferences on fiscal policy stance, i.e., a president from a party of the left, the Democratic Party, may be more willing to expand the government budget. The latter is motivated by the argument that a divided government, stuck in a gridlock, may spend more because, in such a situation, passing a budget bill requires compromises, resulting in a swollen budget (e.g., Alt and Lowry (1994)). The signs of the added dummies are estimated as expected but the estimates are not statistically significant[13]. This means that the additional dummies do not alter the baseline result.

For the second exercise, we re-estimate the baseline model separately for two subsamples based on the president's party affiliation, either Democrat or Republican. This exercise sees whether the U-shaped function in the baseline estimation results from ideological differences in the preferences for public finance; i.e., whether a president from the left, especially if he is likely to lose the election, attempts to expand the budget, whereas a president from the right does the

[11] Supplementary Material, S.3.1, Table 1 and Figures 1–4.

[12] Supplementary Material, S.3.2, Table 2 and Figures 5–8.

[13] Supplementary Material, S.3.3, Table 3 column 2 and Figure 9.

opposite, resulting in a nonmonotonic relationship. The estimation results for the subsamples consisting of only Democratic and Republican presidents are likewise U-shaped, implying that both Democrat and Republican presidents have similar incentives to manipulate fiscal policy along this dimension [14].

5.4 Subsample estimation

Fourth, there is a need to check that the U-shaped pattern of the relationship between the approval rate and government consumption does not stem from a particular sample. The baseline model is re-estimated using different subsamples that each exclude a specific presidential term. All the estimation results are very similar to the baseline case and confirm that the baseline finding does not result from outliers [15].

5.5 First difference

Fifth, in stead of the one-sided Hodrik-Prescott filter, we use a first-difference filter to extract trend components in the raw data. The derived data are viewed as a percentage deviations from their own linear trend. The estimation results confirm the baseline finding[16].

5.6 Endogeneity issue

The single-stage regression considered thus far may suffer from endogeneity bias in that the approval rate is a regressor for the fiscal variable (government consumption), but may also be influenced directly or indirectly by fiscal policy.

To deal with such endogeneity, we extend the model by applying the two-stage estimation framework in Wiesenfarth et al. (2014). This consists of the following equations.

$$
\begin{aligned}
Appr_{t-4} &= \varphi + \mathbf{X}_{t-4}\gamma + f_{1,1}\left(Output_{t-4}\right) + f_{1,2}\left(Inflation_{t-4}\right) \\
&\quad + f_{1,3}\left(GovDebt_{t-4}\right) + f_{1,4}\left(Time_{t-4}\right) + \varepsilon_t \\
GovCons_t &= \phi + \rho GovCons_{t-1} + f_{2,1}\left(Term_{t-4}\right) + f_{2,2}\left(Appr_{t-4}\right) + \varepsilon_t,
\end{aligned}
$$

[14]Supplementary Material, S.3.3, Table 3 columns 3–4 and Figures 10 and 11.
[15]Supplementary Material, S.3.4, Tables 4 and 5 and Figures 12–20.
[16]Supplementary Material, S.3.5, Table 7 and Figure 23-25.

where φ is a constant term, X_{t-4} is a matrix containing control variables, γ is a corresponding parameter matrix, ρ is an autocorrelation term, $f_{i,j}, i = 1,2; j = 1,2,...$ are unknown smooth functions for variable j in the first($i = 1$) or second($i = 2$) equation, and ε_t is an error term. All other notation in the second term coincides with that in the single-stage regression. $Appr$ in the second (main) equation is replaced with the fitted value obtained from the first equation. See Supplementary Material, S.2.2, for an overview of the inference.

The specification of the first equation closely follows Berlemann et al. (2014), whereby voters reward a government that achieves a favourable economic situation: higher economic activity, lower inflation and healthier public finances. In addition to economic variables, three kinds of political variables are included. The first is divided government dummies, whose definition is the same as in the single-stage estimation. Under a divided government, the president is less likely to be blamed severely for negative factors, so presidential approval is higher. For the second, we introduce seven political event dummies to control for high-profile political events. The timing of these dummies is from Newman and Forcehimes (2010), who identify 120 events based on the front page coverage of the *New York Times*, and classify these events into seven groups: negative/positive domestic events, negative/positive foreign events, positive diplomatic events and negative/positive personal events. Three significant events, namely the Watergate affair, the Gulf War (Operation Desert Storm) and the 9/11 terrorist attacks, are controlled by three independent dummies. Finally, figures of quarterly casualties for the military conflicts in Vietnam, Afghanistan and Iraq are included. Voters are supposed to punish a government mired in a costly war. Finally, president-specific dummies are included. Clinton's period of office is chosen as the reference because it included no major political events or wars. Further information on the data source is available in Supplementary Material, S.1.

The estimation results of the first equation are largely consistent with Berlemann et al. (2014)[17]. As in the baseline estimation, the estimated effects of the term in office are not significant [18]. Given that the simultaneous credible interval is inclined to be conservative (Wiesenfarth et al. (2014)), the estimated effects of the approval rate lose statistical significance but the aforementioned U-shaped pattern is still evident [19]. These findings imply that the endogeneity of the approval rate does not yield significant distortion in the baseline regression.

[17]Supplementary Material, S.3.6, Table 8 and Figure 26 (a)–(d).
[18]Supplementary Material, S.3.5, Figure 21 (e).
[19]Supplementary Material, S.3.5, Figure 21 (f).

6 Conclusion

This paper estimates the functional effects of the US president's re-election probability (or popularity) and term in office (or tenure) on the US federal budget using a semiparametric regression technique. The findings obtained from the estimation are twofold. First, the estimated effects of the term in office on fiscal policy are not statistically significant; i.e., there is no evidence of a political budget cycle in the sample. Second, government consumption decreases when the race for office is neck-and-neck, while it increases when the incumbent is either certain to win or certain to lose the next election; i.e., the estimated functional effects of the approval rate on government consumption are U-shaped. The second finding is largely consistent with Martinez's (2009) theoretical model that if US voters are fiscal conservatives, the incumbent reduces federal government consumption to signal competence to voters. The estimated functional effects are invariant with respect to the presidential term, which means that while there is no popularity-conditional political budget cycle, political manipulation of the budget occurs independently of the presidential term.

References

Aidt, T. S., Veiga, F. J., and Veiga, L. G. (2011). Election results and opportunistic policies: a new test of the rational political business cycle model. *Public Choice*, 148(1-2):21–44.

Alesina, A., Perotti, R., Tavares, J., Obstfeld, M., and Eichengreen, B. (1998). The political economy of fiscal adjustments. *Brookings Papers on Economic Activity*, pages 197–266.

Alesina, A. and Tabellini, G. (1990). A positive theory of fiscal deficits and government debt. *Review of Economic Studies*, 57(3):403–414.

Alt, J. E. and Lassen, D. D. (2006a). Fiscal transparency, political parties, and debt in oecd countries. *European Economic Review*, 50(6):1403–1439.

Alt, J. E. and Lassen, D. D. (2006b). Transparency, political polarization, and political budget cycles in oecd countries. *American Journal of Political Science*, 50(3):530–550.

Alt, J. E. and Lowry, R. C. (1994). Divided government, fiscal institutions, and budget deficits: Evidence from the states. *American Political Science Review*, 88(04):811–828.

Alt, J. E. and Rose, S. S. (2009). Context-conditional political budget cycles. In Boix, C. and Stokes, S. C., editors, *The Oxford Handbook of Comparative Politics*, chapter 34. Oxford University Press.

Beck, T., Clarke, G., Groff, A., Keefer, P., and Walsh, P. (2001). New tools in comparative political economy: The database of political institutions. *The World Bank Economic Review*, 15(1):165–176.

Berlemann, M., Enkelmann, S., and Kuhlenkasper, T. (2014). Unraveling the relationship between presidential approval and the economy: a multidimensional semiparametric approach. *Journal of Applied Econometrics*.

Born, B., Peter, A., and Pfeifer, J. (2013). Fiscal news and macroeconomic volatility. *Journal of Economic Dynamics and Control*, 37(12):2582–2601.

Brender, A. (2003). The effect of fiscal performance on local government election results in israel: 1989–1998. *Journal of Public Economics*, 87(9):2187–2205.

Brender, A. and Drazen, A. (2005). Political budget cycles in new versus established democracies. *Journal of Monetary Economics*, 52(7):1271–1295.

Brender, A. and Drazen, A. (2008). How do budget deficits and economic growth affect reelection prospects? evidence from a large panel of countries. *American Economic Review*, 98(5):2203–20.

Buti, M., Turrini, A., Van den Noord, P., and Biroli, P. (2010). Reforms and re-elections in oecd countries. *Economic Policy*, 25(61):61–116.

de Haan, J. and Klomp, J. (2013). Conditional political budget cycles: a review of recent evidence. *Public Choice*, 157(3-4):387–410.

Drazen, A. (2001). The political business cycle after 25 years. In *NBER Macroeconomics Annual 2000, Volume 15*, pages 75–138. MIT Press.

Drazen, A. and Eslava, M. (2010). Electoral manipulation via voter-friendly spending: theory and evidence. *Journal of Development Economics*, 92(1):39–52.

Efthyvoulou, G. (2012). Political budget cycles in the european union and the impact of political pressures. *Public Choice*, 153(3-4):295–327.

Enkelmann, S. and Leibrecht, M. (2013). Political expenditure cycles and election outcomes: evidence from disaggregation of public expenditures by economic functions. *Economics Letters*, 121(1):128–132.

Fair, R. C. (1996). Econometrics and presidential elections. *Journal of Economic Perspectives*, 10(3):89–102.

Fiva, J. H. and Natvik, G. J. (2013). Do re-election probabilities influence public investment? *Public Choice*, 157(1-2):305–331.

Frey, B. S. and Schneider, F. G. (1978). An empirical study of politico-economic interaction in the united states. *Review of Economics and Statistics*, 60(2):174–83.

Hanusch, M. and Magleby, D. B. (2014). Popularity, polarization, and political budget cycles. *Public Choice*, 159(3-4):457–467.

Holmström, B. (1999). Managerial incentive problems: a dynamic perspective. *Review of Economic Studies*, 66(1):169–182.

Jones, J. B. (2002). Has fiscal policy helped stabilize the postwar us economy? *Journal of Monetary Economics*, 49(4):709–746.

Katsimi, M. and Sarantides, V. (2012). Do elections affect the composition of fiscal policy in developed, established democracies? *Public Choice*, 151(1-2):325–362.

Lang, S. and Brezger, A. (2004). Bayesian p-splines. *Journal of Computational and Graphical Statistics*, 13(1):183–212.

Leeper, E. M., Richter, A. W., and Walker, T. B. (2012). Quantitative effects of fiscal foresight. *American Economic Journal: Economic Policy*, 4(2):115–144.

Leeper, E. M., Walker, T. B., and Yang, S.-C. S. (2010). Government investment and fiscal stimulus. *Journal of Monetary Economics*, 57(8):1000–1012.

Martinez, L. (2009). A theory of political cycles. *Journal of Economic Theory*, 144(3):1166–1186.

Newman, B. and Forcehimes, A. (2010). Rally round the flag events for presidential approval research. *Electoral Studies*, 29(1):144–154.

Nordhaus, W. D. (1975). The political business cycle. *Review of Economic Studies*, 42(2):169–90.

Panzer, J. and Paredes, R. D. (1991). The role of economic issues in elections: the case of the 1988 chilean presidential referendum. *Public Choice*, 71(1-2):51–59.

Peltzman, S. (1990). How efficient is the voting market? *Journal of Law and Economics*, 33(1):27–63.

Peltzman, S. (1992). Voters as fiscal conservatives. *Quarterly Journal of Economics*, 107(2):327–361.

Pettersson-Lidbom, P. (2001). An empirical investigation of the strategic use of debt. *Journal of Political Economy*, 109(3):570–583.

Price, S. (1998). Comment on the politics of the political business cycle. *British Journal of Political Science*, 28(01):185–222.

Ramey, V. A. (2011). Identifying government spending shocks: it's all in the timing. *Quarterly Journal of Economics*, 126(1):1–50.

Ramey, V. A. and Shapiro, M. D. (1998). Costly capital reallocation and the effects of government spending. In *Carnegie-Rochester Conference Series on Public Policy*, volume 48, pages 145–194. Elsevier.

Rogoff, K. S. (1990). Equilibrium political budget cycles. *American Economic Review*, 80(1):21–36.

Schmitt-Grohé, S. and Uribe, M. (2012). What's news in business cycles. *Econometrica*, 80(6):2733–2764.

Schneider, C. J. (2010). Fighting with one hand tied behind the back: political budget cycles in the west german states. *Public Choice*, 142(1-2):125–150.

Schultz, K. A. (1995). The politics of the political business cycle. *British Journal of Political Science*, 25(01):79–99.

Shi, M. and Svensson, J. (2003). Political budget cycles: a review of recent developments. *Nordic Journal of Political Economy*, 29(1):67–76.

Stock, J. H. and Watson, M. W. (1999). Forecasting inflation. *Journal of Monetary Economics*, 44(2):293–335.

Tanaka, M. (forthcoming). Electoral uncertainty and fiscal poolicy in general equilibrium. Technical report, Waseda University.

Wiesenfarth, M., Hisgen, C. M., Kneib, T., and Cadarso-Suarez, C. (2014). Bayesian nonparametric instrumental variables regression based on penalized splines and dirichlet process mixtures. *Journal of Business & Economic Statistics*, 32(3):468–482.

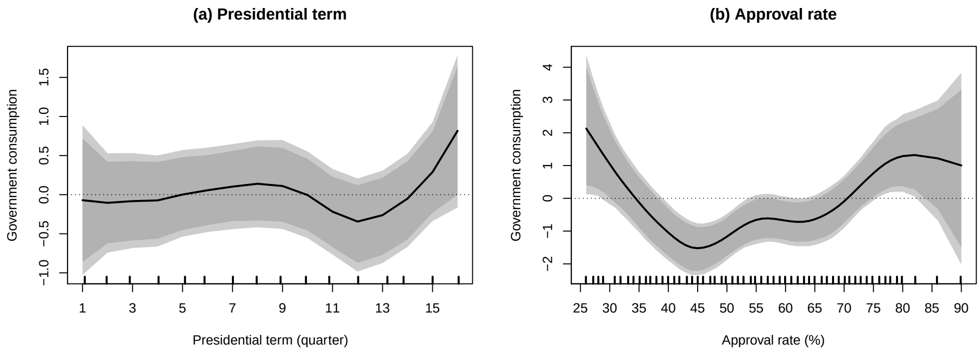
Yang, S. S.-C. (2005). Quantifying tax effects under policy foresight. *Journal of Monetary Economics*, 52(8):1557–1568.

Table 1: Estimation results for government consumption

Covariate	Estimate	
	Baseline	With interaction
(Intercept)	0.55	0.26
	[0.06, 1.05]	[- 0.12, 0.67]
Autocorrelation	0.61	0.65
	[0.51, 0.71]	[0.54, 0.75]
Approval rate$(t-4)$	Figure 1 (a)	–
Presidential term$(t-4)$	Figure 1 (b)	–
Approval rate$(t-4)\times$Presidential Term$(t-4)$	–	Figure 2
DIC	253.68	249.35

Note: The 95% credible interval for the parametric estimate is in brackets.

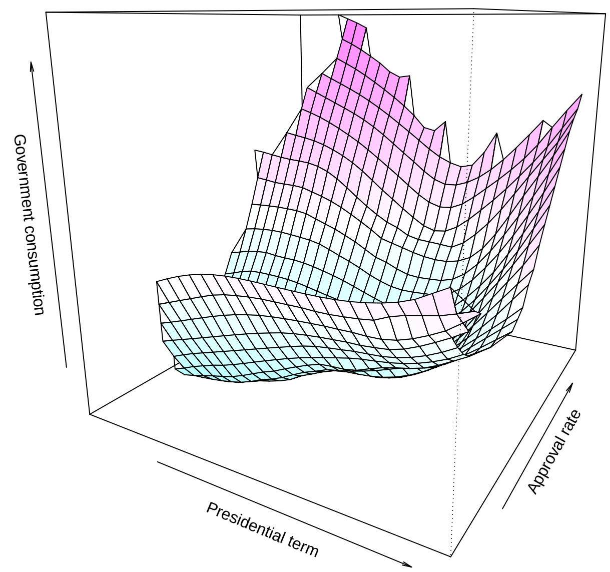
Figure 1: Estimated effects on government consumption



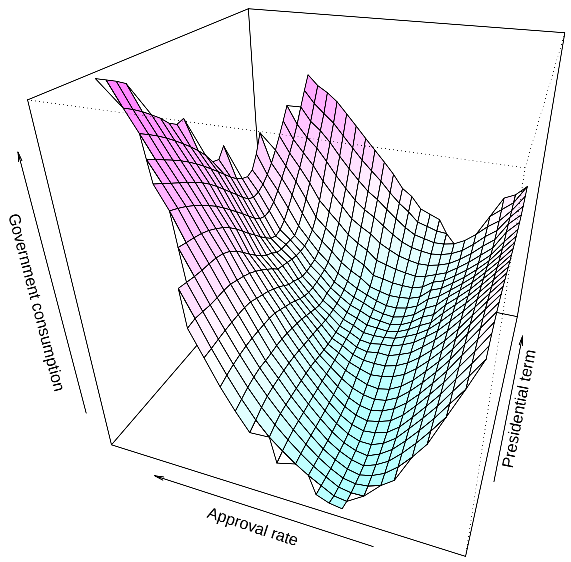
Note: The shaded areas depict 90 and 95% pointwise credible intervals.

Figure 2: Estimated effects on government consumption

(a)



(b)



Supplementary Material for "Measuring Political Budget Cycles: A Bayesian Semiparametric Assessment" (not for publication)

Masahiro Tanaka

Waseda University

12/26/2014

S.1 Data

The construction of fiscal variables closely follows Jones (2002) and the recent literature on empirical dynamic stochastic general equilibrium (DSGE) analysis, e.g., Leeper et al. (2010).

Output = (1).

(1) Gross domestic product deflator (NIPA Table 1.1.4, line 1).

Private investment = (2) + (3).

(2) Fixed investment, nonresidential (NIPA Table 1.1.5, line 9).

(3) Fixed investment, residential (NIPA Table 1.1.5, line 13).

Hours worked = (4) $\times$ (5).

(4) Nonfarm business hours worked index, base year = 2009 (BLS, PRS85006023).

(5) Employment level, 16 years and over (CPS, LNS12000000Q), adjusted as 2009 = 1.

Government consumption = (6) + (7) + (8) – (9).

(6) Federal government current receipts and expenditures, federal government, consumption expenditures (NIPA Table 3.2, line 21).

(7) Federal government current receipts and expenditure, net purchases of nonproduced assets (NIPA Table 3.2, Table 43). The data for 1953Q1:1959Q2 are backwards-interpolated by the four-quarter moving average[20].

(8) Federal government current receipts and expenditures, consumption of fixed capital (NIPA Table 3.2, line 44).

(9) Government consumption expenditures and gross investment, government, national defense, gross investment (NIPA Table 3.9.5, line 19).

[20]The fraction in 1950–60 is quite small so that it has almost no influence on the result. See the results for the subsample excluding Eisenhower's term (1953Q1-1961Q4), Supplementary Material, S.3.4, Figure 12.

Government investment = (10).

(10) Federal government current receipts and gross investment, government, national defense, gross investment (NIPA Table 3.2, line 41)

Capital income = (11) + (12) + (13) + (14).

(11) National income by type of income, proprietor's income with IVA and CCAdj (NIPA Table 1.12, line 9)

(12) National income by type of income, rental income (NIPA Table 1.12, line 12)

(13) National income by type of income, corporate profits (NIPA Table 1.12, line 13)

(14) National income by type of income, net interest and miscellaneous payments (NIPA Table 1.12, line 18)

Average personal income tax rate = (15) ÷ { (16) + 0.5 × (11) + (Capital income) }.

(15) Federal government current receipts and expenditures, personal current tax revenues (NIPA Table 3.2, line 3)

(16) National income by type of income, wage and salary (NIPA Table 1.12, line 3)

Labour income tax revenue = (Average personal income tax rate) ÷ (16) + 0.5 × (11) } + (17).

(17) Federal government current receipts and expenditures, contributions to government social insurance (NIPA Table 3.2, line 11)

Capital income tax revenue = (Average personal income tax rate) × (Capital income) + (18).

(18) Federal government current receipts and expenditures, taxes on corporate income (NIPA Table 3.2, line 7)

Average labour income tax rate = [(Average personal income tax rate) ÷ { (16) + 0.5 × (11) } + (17)] ÷ { (19) + 0.5 × (11) }.

(19) National income by type of income, compensation of employees (NIPA Table 1.12, line 2)

Average capital income tax rate = { (Average personal income tax rate) $\times$ (Capital income)}.

Total tax revenue = { (Labour income tax revenue) + (Capital income tax revenue) + (18) } $\div$ { (Capital income) + (18)}.

Tax residual = (20) + (17) + (21) + (22) – (Total tax revenue).

(20) Federal government current receipts and expenditures, current tax receipts (NIPA Table 3.2, 2)

(21) Federal government current receipts and expenditures, income receipts on assets (NIPA Table 3.2, line 12)

(22) Federal government current receipts and expenditures, current surplus of government enterprises (NIPA Table 3.2, line 19)

Government transfers = (22) - (23) + (24) – (25) + (26) – (Tax residual).

(22) Federal government current receipts and expenditures, current transfer payments (NIPA Table 3.2, line 22)

(23) Federal government current receipts and expenditures, current transfer receipts (NIPA Table 3.2, line 16)

(24) Federal government current receipts and expenditures, capital transfer payments (NIPA Table 3.2, line 42)

(25) Federal government current receipts and expenditures, capital transfer receipts (NIPA Table 3.2, line 38)

(26) Federal government current receipts and expenditures, Subsidies (NIPA Table 3.2, line 32)

Scaling All the nominal data are divided by (27). All the quantitative data are divided by (28).

(27) Gross domestic deflator (NIPA Table 1.1.4, line 1)

(28) Civilian noninstitutional population (BLS, LNU00000000Q), adjusted as 2009 = 1

Political events Appendix of Newman and Forcehimes (2010), pp. 153–154.

Casualties in Vietnam, Afghanistan and Iraq

(Vietnam) The casualties in Vietnam are obtained from the National Archives, Defense Casualty Analysis System (DCAS) Public Use File, 1950–2005[21]. The data are constructed by searching partial records that include (1) "VIETNAM CONFLICT" and "KILLED IN ACTION", and (2) "VIETNAM CONFLICT" and "DIED OF WOUNDS", and then counting the hit entries[22].

(Afghanistan and Iraq) Casualties for Afghanistan and Iraq are available from the Department of Defense, Defense Casualty Analysis System. Total number of casualties by month – killed in action and died of wounds[23].

S.2 Inference

Single-stage estimation is conducted using the Bayesian P-splines approach developed by Lang and Brezger (2004). The exposition and notation in this subsection are from Lang and Brezger (2004). Note that the notation used here differs from that used in the main text of this paper.

Consider a generalised additive regression model with one-dimensional functional effects

$$y_i = f_1(x_1) + \cdots + f_p(x_p) + \mathbf{v}_i'\gamma. + \varepsilon_i$$

and the corresponding predictor

$$\eta_i = f_1(x_{i1}) + \cdots f_p(x_{ip}) + \mathbf{v}_i'\gamma,$$

where $\mathbf{x} = (x_1, ..., x_p)'$ is a vector of metrical covariates for the nonparametrical part, and $\mathbf{v} = (v_1, ..., v_q)'$ is a vector of covariates for the parametrical part. An unknown function f_j is approximated by a spline of degree l with equally spaced knots $x_{j,min} = \zeta_{j0} < \zeta_{j1} < \cdots < \zeta_{j,r-1} < \zeta_{jr} = x_{j,max}$ within the domain of x_j. The spline can be written in terms of a linear combination of

[21] http://aad.archives.gov/aad/series-description.jsp?s=4772&cat=all&bc=sl

[22] The coverage of the figures for the Vietnam War is different from Berlemann et al. (2014). The data they use are limited to the number of people killed in action, which are inconsistent with the data on the other two wars, which include the number of people who died of wounds. The data used in the present paper consistently cover two figures for all three military conflicts. On the other hand, the data used in their paper and the present paper are quite similar in that the number who died of wounds is much smaller than the number killed in action.

[23] 11-F-0673_GWOT_Casualties_as_of_9_Jul_12.xls

$m = r + l$ B-spline basis functions $B_{j\rho}$:

$$f_j(x_j) = \sum_{\rho=1}^{m} \beta_{j\rho} B_{j\rho}(x_j).$$

In the present paper, the number of knots is set to 40. Define design matrices $\mathbf{X}_j$ and their generic elements $X_j(i,\rho) = B_{j,\rho}(x_{i,j})$. Then the predictor of the model is written in matrix form as

$$\eta = \mathbf{X}_1\beta_1 + \cdots + \mathbf{X}_p\beta_p + \mathbf{V}'\gamma,$$

where $\beta_j = (\beta_{j1,\ldots,}\beta_{jm})'$, $j = 1,\ldots,p$ denotes a parameter vector to be estimated.

In a Bayesian P-splines approach, unknown parameters are considered to be random variables and are supplemented with prior distributions. For the parameters for the parametric part γ, independent diffuse priors are assigned, $\gamma_j \propto constant, j = 1,\ldots,q$. Priors for the parameters for the nonparametric part β_j are set to a second-order random walk:

$$\beta_{j\rho} = 2\beta_{j,\rho-1} - \beta_{j,\rho-2} + u_{j\rho},$$

where $u_{j\rho} \sim N\left(0,\tau_j^2\right)$. τ_j^2 controls the trade-off between the flexibility and smoothness of the estimates. The initial values are set to $\beta_{j1}, \beta_{j2} \propto constant$. The priors can be written in the form of global smoothness priors

$$\beta_j \mid \tau_j^2 \propto \exp\left(-\frac{1}{2\tau_j^2}\beta_j'\mathbf{K}_j\beta_j\right),$$

where K_j is a penalty matrix. Hyperparameters for τ_j^2 are given by gamma priors $p\left(\tau_j^2\right) \sim IG(1, 0.005)$, following a common choice.

If the model contains a two-dimensional smooth function $f_{js}(x_j,x_s)$, it can be approximated by the tensor product of the two-dimensional B-splines

$$f_{js}(x_j,x_s) = \sum_{\rho=1}^{m}\sum_{\nu=1}^{m} \beta_{js\rho\nu} B_{j\rho}(x_j) B_{s\nu}(x_s).$$

The prior based on the four nearest neighbours is defined by

$$\beta_{js\rho\nu} \mid \cdot \sim N\left(\frac{1}{4}\left(\beta_{js\rho-1,\nu} + \beta_{js\rho+1,\nu} + \beta_{js\rho,\nu-1} + \beta_{js\rho,\nu-1}\right), \frac{\tau_{js}^2}{4}\right)$$

for $\rho, \nu = 2, ..., m-1$, with constraints and appropriate changes for corners and edges (Lang and Brezger (2004), pp. 188–189).

The inference is based on Markov chain Monte Carlo (MCMC) techniques. The estimation makes use of an R package R2BayesX (version 0.3-1) developed by Nikolaus Umlauf, Thomas Kneib and Achim Zeileis[24]. Initially, 10,000 iterations are discarded for burn-in, and every 10th iteration of the subsequent 50,000 simulations is used for posterior estimates. The reported DIC (deviance information criterion) is the average of 50 iterations with different seeds for the random number generator. The estimates are robust to alternative choices of priors; these results are available upon request from the author.

The two-stage estimation and the simultaneous credible intervals follow the nonparametric instrumental variable regression framework developed by Wiesenfarth et al. (2014).

The choice of priors follows the recommendation of Wiesenfarth et al. (2014). See Section 2.4 (pp. 472–473) of their paper for details. The estimation uses an R package bayesIV available from Manuel Wiesenfarth's website [25]. As in the single-stage regression, the initial 10,000 iterations are discarded for burn-in and every 10th iteration of the subsequent 50,000 iterations is used for posterior estimates.

[24] http://cran.r-project.org/web/packages/R2BayesX/index.html

[25] http://froelich.vwl.uni-mannheim.de/3347.0.html

S.3 Robustness checks

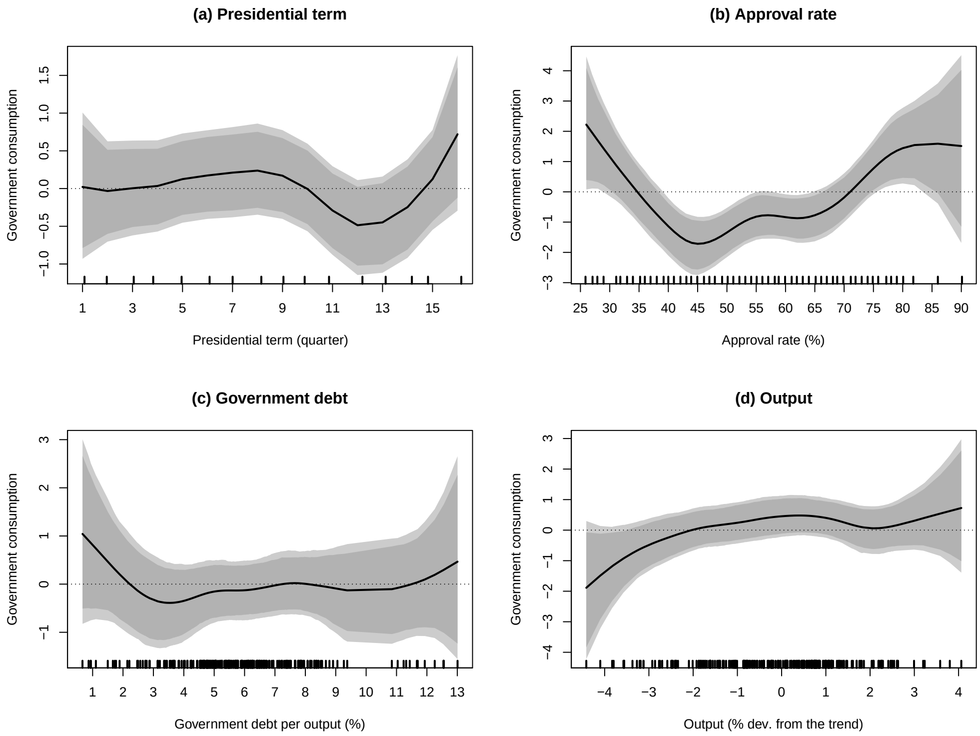
S.3.1 Controlling economic situations

Table 1: Estimation results

Covariate	Estimates			
	Spec (1)	Spec (2)	Spec (3)	Spec (4)
Approval rate$(t-4)$	Figure 1 (a)	Figure 2 (a)	Figure 3 (a)	Figure 4 (a)
Presidential term$(t-4)$	Figure 1 (b)	Figure 2 (b)	Figure 3 (b)	Figure 4 (b)
Government debt$(t-4)$	Figure 1 (c)	Figure 2 (c)	-0.03	-0.11
			[–0.17, 0.11]	[–0.26, 0.04]
Output$(t-4)$	Figure 1 (d)	–	0.08	–
			[–0.10, 0.26]	
Autocorrelation	0.60	0.61	0.61	0.61
	[0.50, 0.70]	[0.50, 0.71]	[0..51, 0.71]	[0.52, 0.72]
(Intercept)	0.58	0.57	0.75	0.65
	[–0.10, 1.28]	[–0.08, 1.19]	[–0.15, 1.65]	[–0.22, 1.51]
DIC	264.86	259.87	255.63	255.40

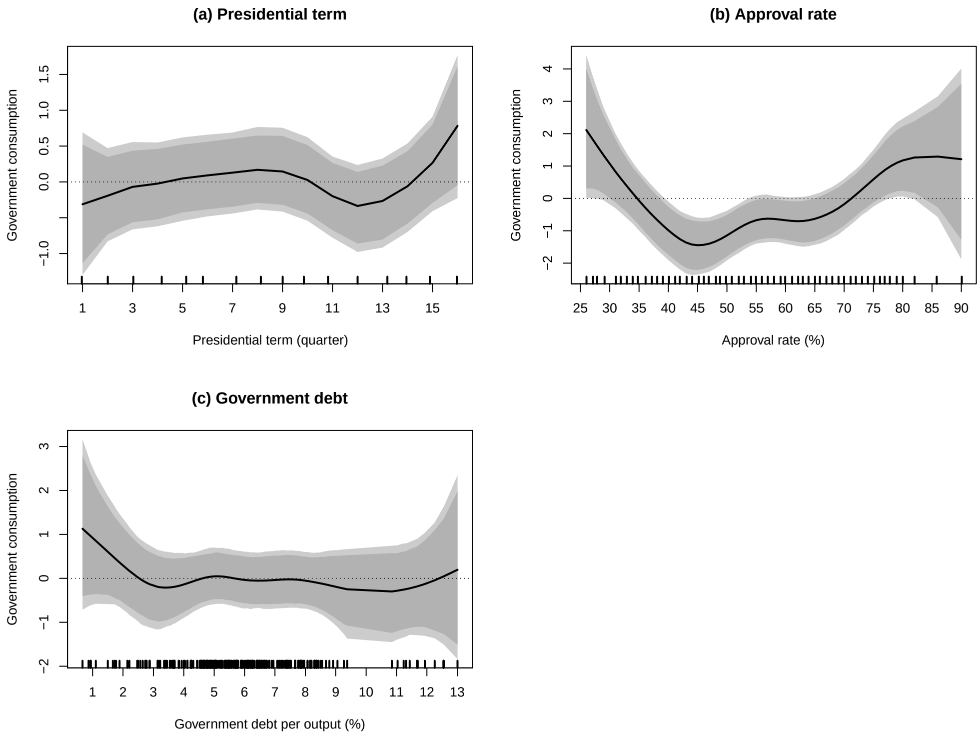
Note: The 95% credible interval is in brackets.

Figure 1: Estimated effects on government consumption, spec (1)



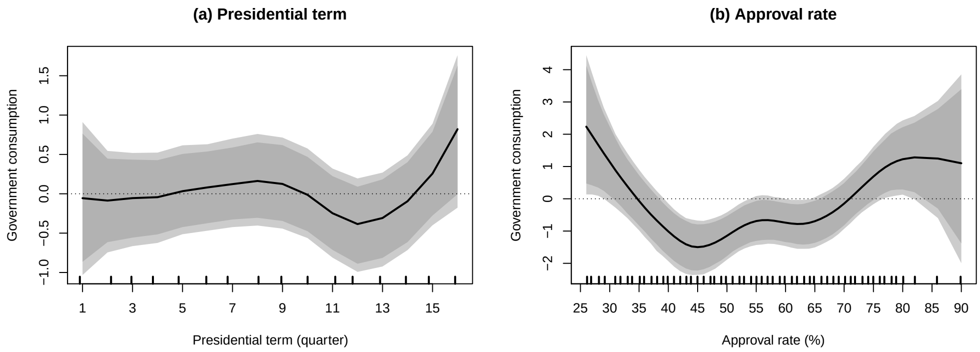
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 2: Estimated effects on government consumption, spec (2)



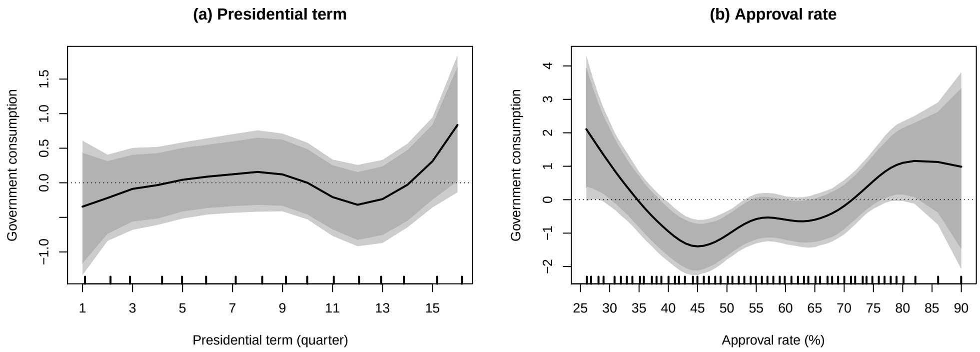
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 3: Estimated effects on government consumption, spec (3)



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 4: Estimated effects on government consumption, spec (4)



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

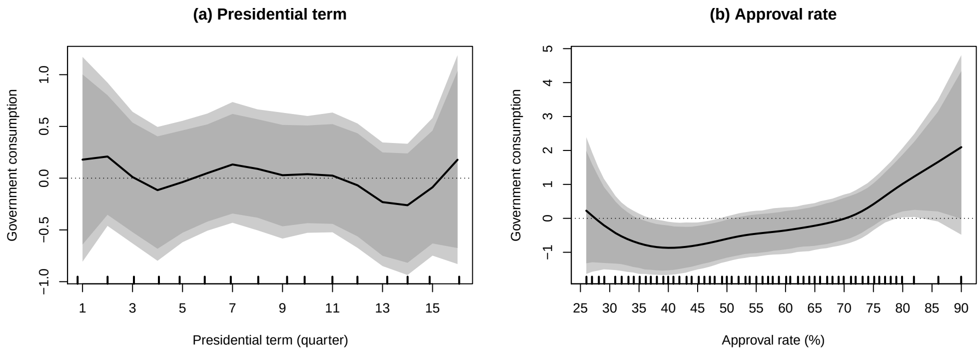
S.3.2 Lag specification

Table 2: Estimation results

Covariate	Estimates			
	$t-2$	$t-3$	$t-5$	$t-6$
Approval rate$(t-4)$	Figure 5 (a)	Figure 6 (a)	Figure 7 (a)	Figure 8 (a)
Presidential term$(t-4)$	Figure 5 (b)	Figure 6 (b)	Figure 7 (b)	Figure 8 (b)
Government debt$(t-4)$	Figure 5 (c)	Figure 6 (c)	Figure 7 (c)	Figure 8 (c)
Output$(t-4)$	Figure 5 (d)	Figure 6 (d)	Figure 7 (d)	Figure 8 (d)
Autocorrelation	0.65	0.64	0.61	0.60
	[0.54, 0.75]	[0.54, 0.74]	[0.51, 0.72]	[0.49, 0.70]
(Intercept)	0.33	0.35	0.29	0.54
	[–0.17, 0.83]	[–0.14, 0.85]	[–0.21, 0.80]	[0.06, 1.06]

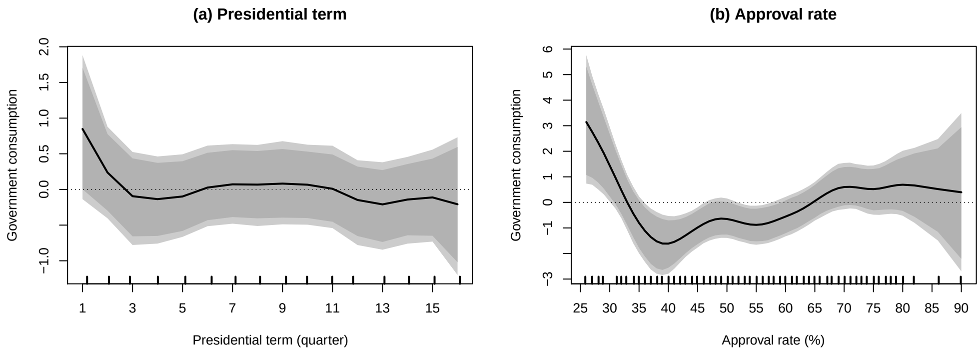
Note: The 95% credible interval is in brackets.

Figure 5: Estimated effects on government consumption, lag $t-2$



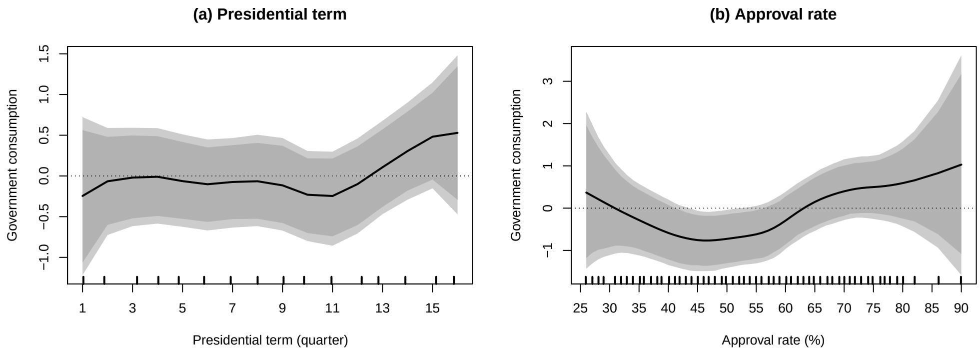
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 6: Estimated effects on government consumption, lag $t-3$



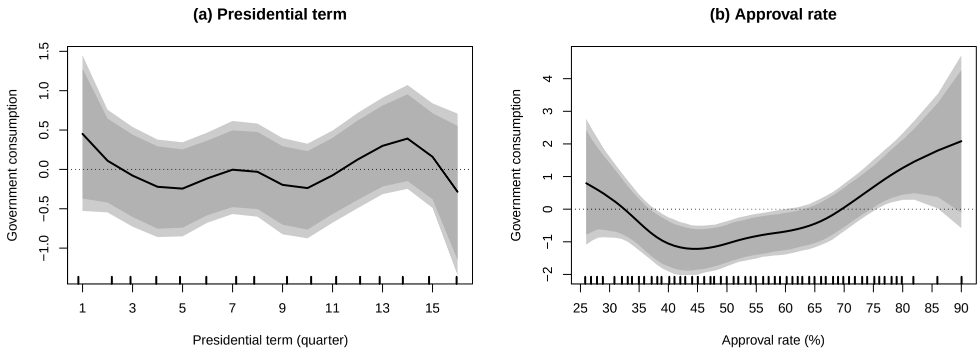
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 7: Estimated effects on government consumption, lag $t-5$



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 8: Estimated effects on government consumption, lag $t-6$



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

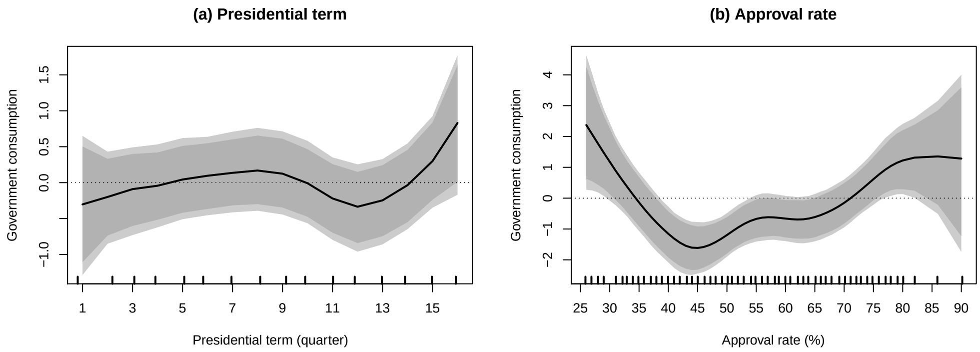
S.3.3 Partisan politics

Table 3: Estimation results

Covariate	Estimates		
	Additional dummies	President's party affiliation	
		Democrats only	Republicans only
Approval rate$(t-4)$	Figure 9 (a)	Figure 10 (a)	Figure 11 (a)
Presidential term$(t-4)$	Figure 9 (b)	Figure 10 (b)	Figure 11 (b)
Democrat dummies$(t-4)$	0.72	–	–
	[0.01, 1.44]		
Divided government dummies$(t-4)$	0.17	0.20	0.57
	[–0.56, 0.92]	[–0.90, 1.36]	[–0.48, 1.61]
Autocorrelation	0.58	0.39	0.55
	[0.48, 0.69]	[0.16, 0.60]	[0.40, 0.69]
(Intercept)	0.17	0.91	–0.32
	[–0.62, 0.96]	[0.18, 1.71]	[–1.33, 0.69]
DIC	256.48	–	–

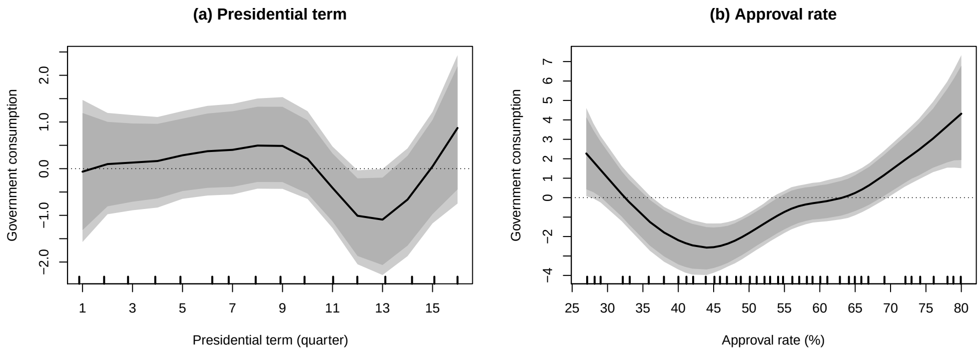
Note: The 95% credible interval is in brackets.

Figure 9: Estimated effects on government consumption, additional dummies



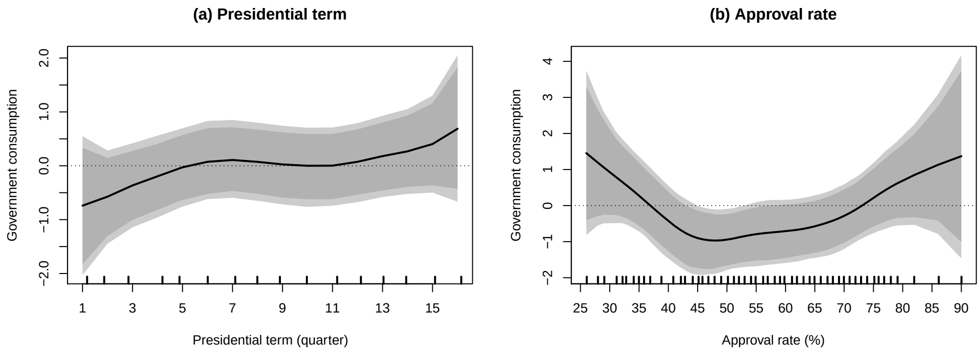
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 10: Estimated effects on government consumption, Democrats only



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 11: Estimated effects on government consumption, Republicans only



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

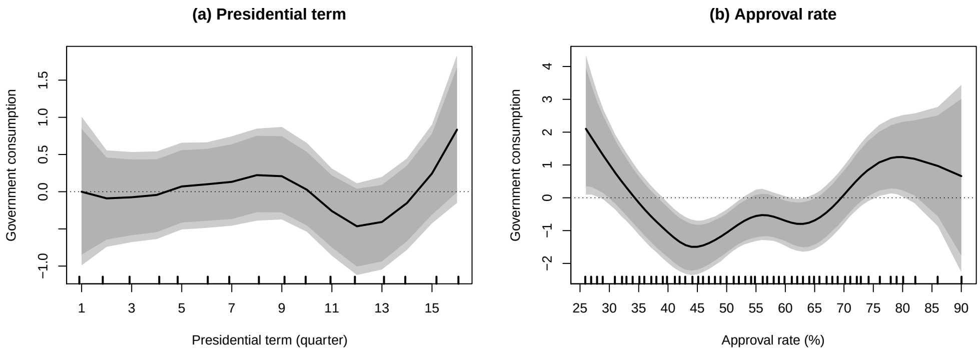
S.3.4 Subsample estimation

Table 4: Estimation results (1/2)

Covariate	Estimates				
	w/o Eisenhower	w/o Kennedy and Johnson	w/o Nixon and Ford	w/o Carter	w/o Reagan
Approval rate$(t-4)$	Figure 12 (a)	Figure 13 (a)	Figure 14 (a)	Figure 15 (a)	Figure 16 (a)
Presidential term$(t-4)$	Figure (b)	Figure (b)	Figure (b)	Figure (b)	Figure (b)
Government debt$(t-4)$	Figure (c)	Figure (c)	Figure (c)	Figure (c)	Figure (c)
Output$(t-4)$	Figure (d)	Figure (d)	Figure (d)	Figure (d)	Figure (d)
Autocorrelation	0.62	0.58	0.56	0.62	0.64
	[0.51, 0.73]	[0.46, 0.69]	[0.45, 0.68]	[0.51, 0.72]	[0.53, 0.74]
(Intercept)	0.58	0.31	0.52	0.45	0.44
	[0.07, 1.09]	[–0.21, 0.84]	[0.06, 0.99]	[–0.06, 0.97]	[–0.05, 0.96]

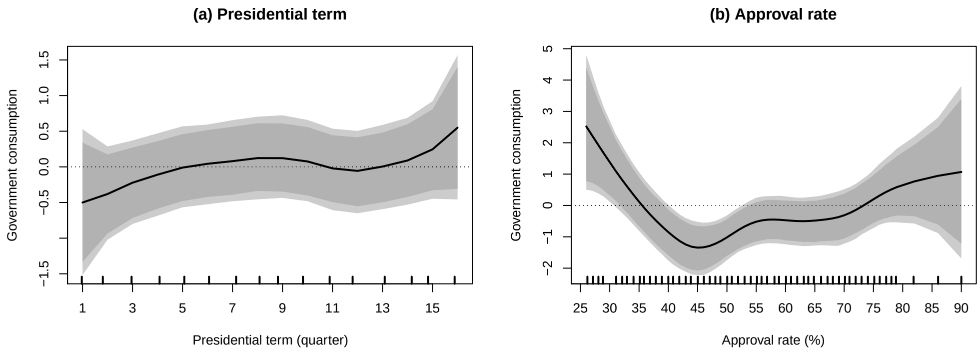
Note: The 95% credible interval is in brackets.

Figure 12: Estimated effects on government consumption, without Eisenhower



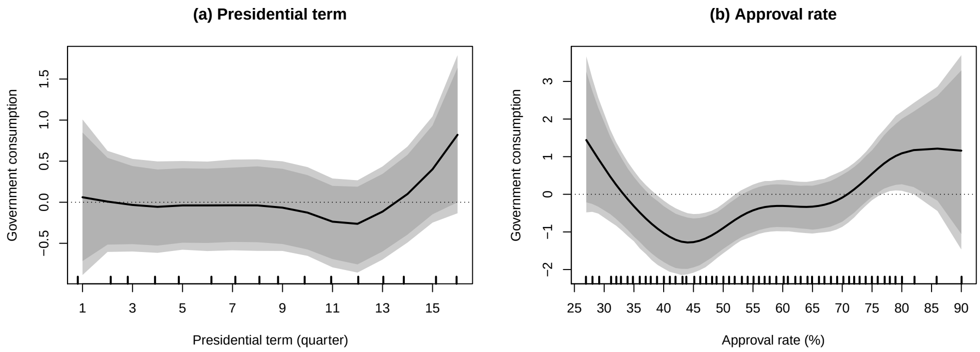
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 13: Estimated effects on government consumption, without Kennedy and Johnson



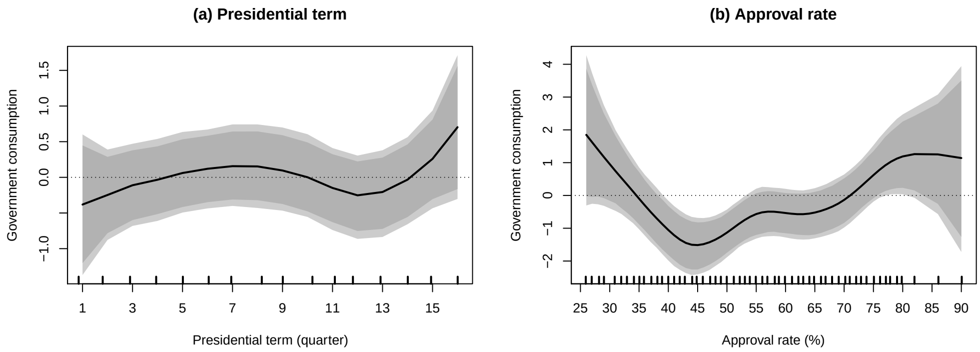
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 14: Estimated effects on government consumption, without Nixon and Ford



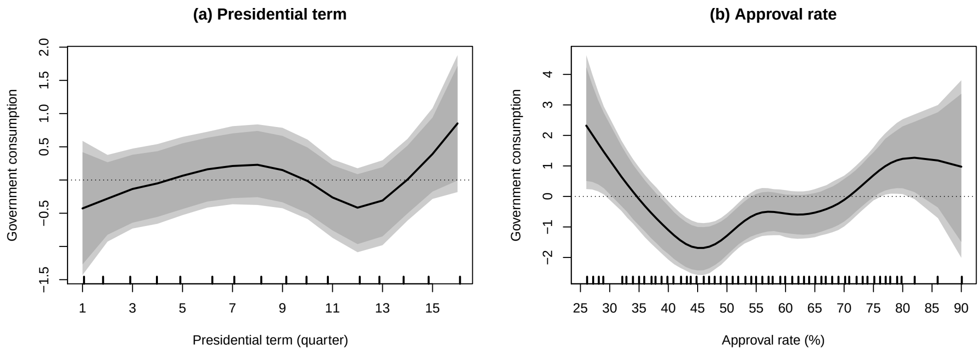
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 15: Estimated effects on government consumption, without Carter



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 16: Estimated effects on government consumption, without Reagan



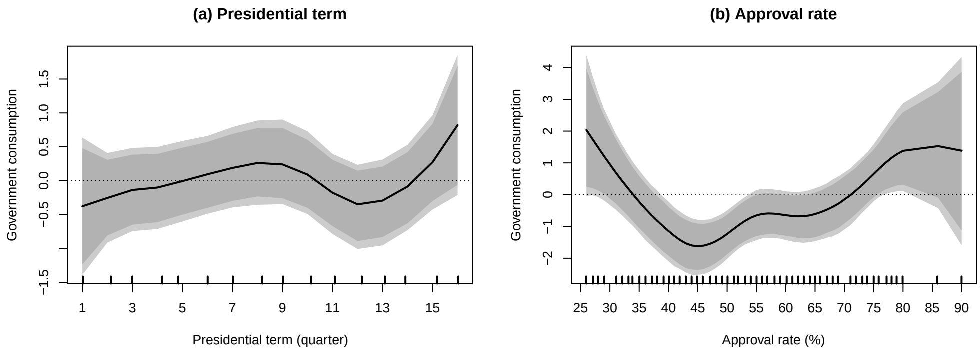
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Table 5: Estimation results (2/2)

Covariate	Estimates			
	w/o Bush Sr	w/o Clinton	w/o Bush Jr	w/o Obama
Approval rate$(t-4)$	Figure 17 (a)	Figure 18 (a)	Figure 19 (a)	Figure 20 (a)
Presidential term$(t-4)$	Figure (b)	Figure (b)	Figure (b)	Figure (b)
Government debt$(t-4)$	Figure (c)	Figure (c)	Figure (c)	Figure (c)
Output$(t-4)$	Figure (d)	Figure (d)	Figure (d)	Figure (d)
Autocorrelation	0.61	0.62	0.63	0.61
	[0.50, 0.71]	[0.51, 0.73]	[0.52, 0.73]	[0.51, 0.72]
(Intercept)	0.58	0.49	0.30	0.48
	[0.04, 1.14]	[–0.02, 1.02]	[–0.11, 0.75]	[–0.03, 1.01]

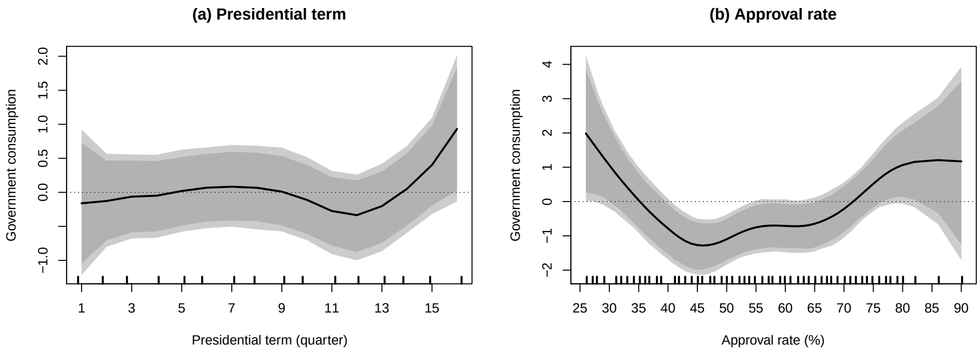
Note: The 95% credible interval is in brackets.

Figure 17: Estimated effects on government consumption, without Bush Sr



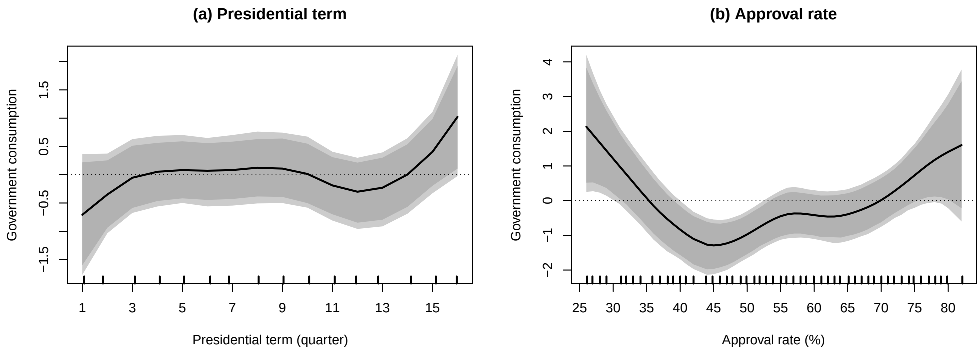
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 18: Estimated effects on government consumption, without Clinton



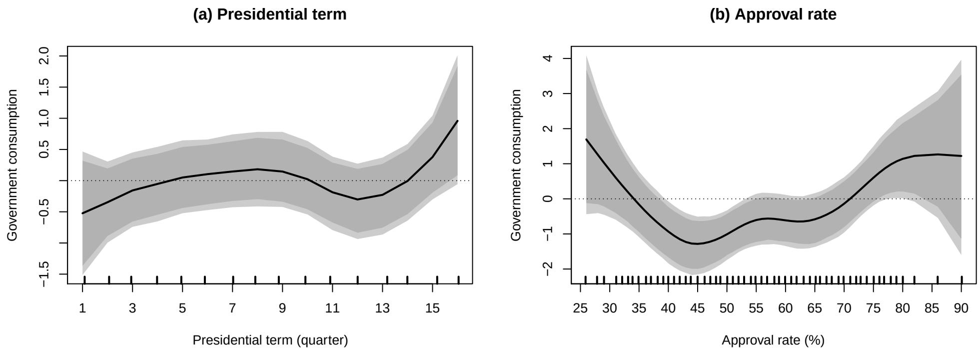
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 19: Estimated effects on government consumption, without Bush Jr



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 20: Estimated effects on government consumption, without Obama



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

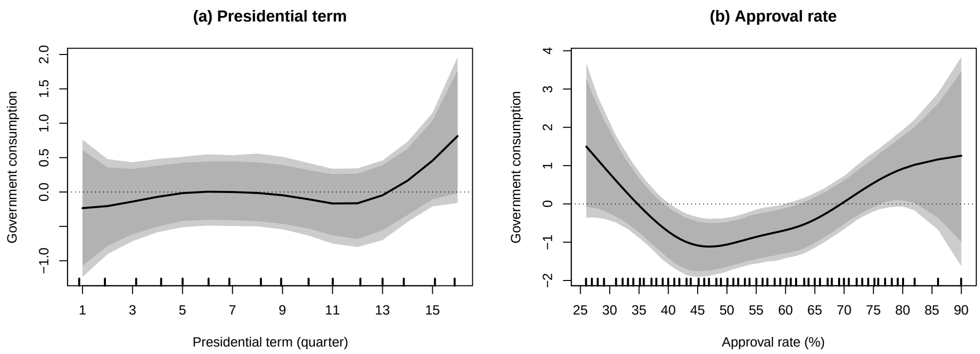
S.3.5 First difference

Table 6: Estimation results

Covariate	Estimates		
	Spec (F1)	Spec (F2)	Spec (F3)
Approval rate$(t-4)$	Figure 23 (a)	Figure 24 (a)	Figure 25 (a)
Presidential term$(t-4)$	Figure 23 (b)	Figure 24 (b)	Figure 25 (b)
Government debt$(t-4)$	–	Figure 24 (c)	0.41
			[–0.14, 0.95]
Output$(t-4)$	–	Figure 24 (d)	0.26
			[–0.15, 0.68]
Autocorrelation	–0.35	–0.32	–0.35
	[–0.47, –0.22]	[–0.45, –0.22]	[–0.47, –0.23]
(Intercept)	0.51	0.00	0.49
	[–0.01, 1.02]	[–1.12, 1.78]	[–0.03, 1.01]

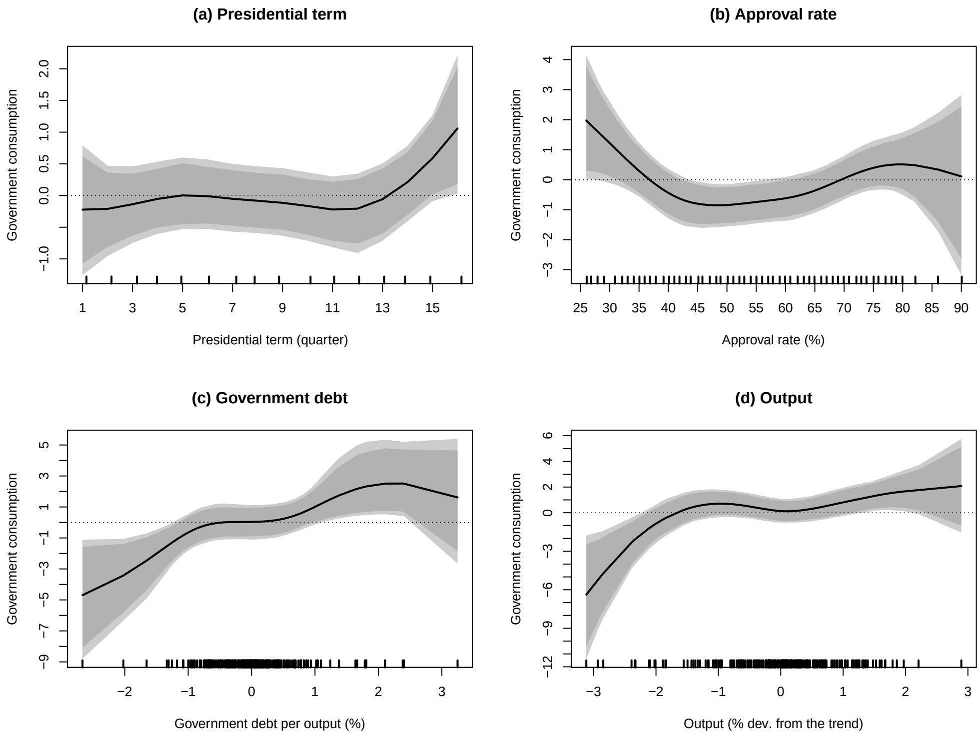
Note: The 95% credible interval is in brackets.

Figure 21: Estimated effects on government consumption, spec (F1)



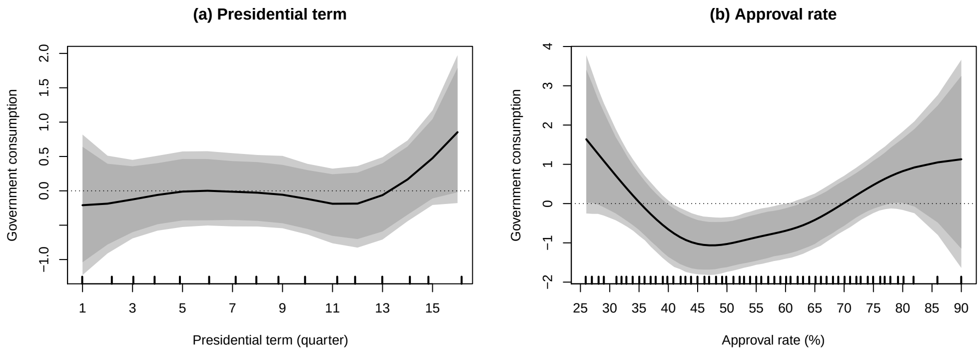
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 22: Estimated effects on government consumption, spec (F2)



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 23: Estimated effects on government consumption, spec (F3)



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

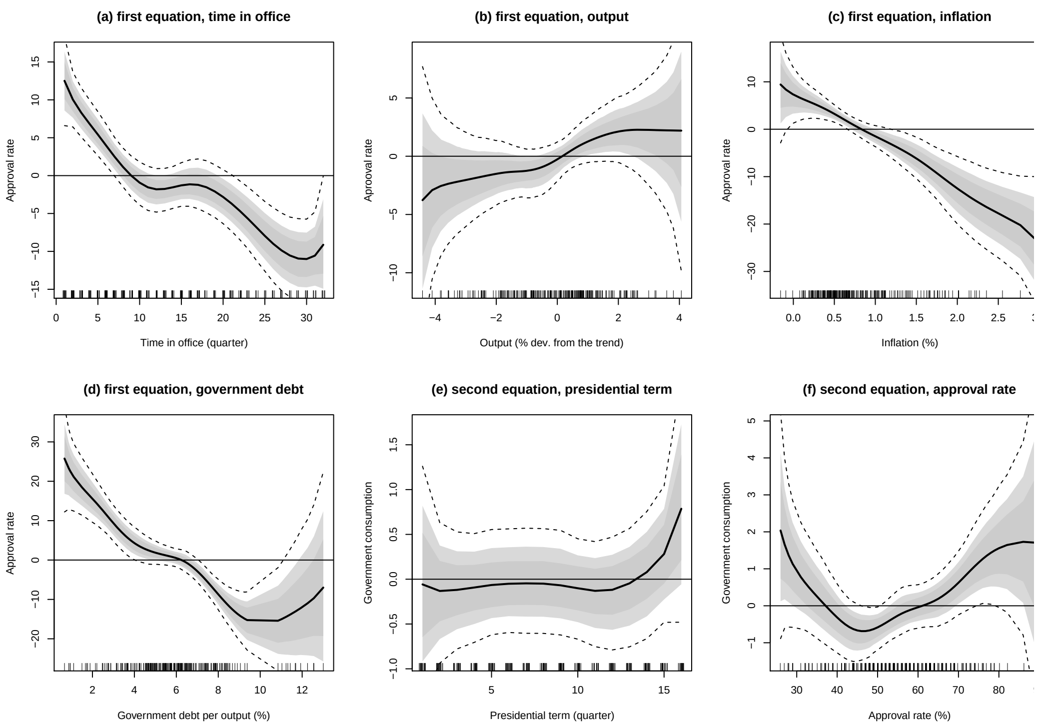
S.3.6 Endogeneity issue

Table 7: Results of the two-stage estimation, first equation

Covariate	Estimate	Covariate	Estimate
First equation			
Time in office	Figure 26 (a)	Divided government	3.11
			[–0.67, 6.77]
Output	Figure 26 (b)	Eisenhower	12.90
			[9.23, 16.63]
Inflation	Figure 26 (c)	Kennedy	12.69
			[7.15, 18.31]
Government debt	Figure 26 (d)	Johnson	13.33
			[8.28, 18.32]
Watergate affair	-18.41	Nixon	17.18
	[–26.41, –10.38]		[11.89, 22.48]
Operation Desert Storm	21.80	Ford	11.95
	[13.36, 30.11]		[4.80, 19.38]
9/11	14.55	Carter	10.74
	[1.65, 27.54]		[3.81, 17.56]
Casualties in Vietnam	–0.00	Reagan	14.01
	[–0.00, –0.00]		[9.31, 18.88]
Casualties in Afghanistan	-0.08	Bush Sr	11.83
	[–0.15, –0.02]		[6.32, 17.84]
Casualties in Iraq	-0.06	Bush Jr	12.21
	[–0.09, –0.03]		[6.80, 17.37]
Negative domestic events	-2.33	Obama	15.85
	[–5.29, 0.47]		[3.21, 27.74]
Negative foreign events	2.04	(Intercept)	42.59
	[–3.44, 7.40]		[38.53, 46.62]
Negative personal events	0.58		
	[–3.66, 4.73]	**Second equation**	
Positive domestic events	6.23	Approval rate$(t-4)$	Figure 26 (e)
	[–0.45, 13.09]		
Positive foreign events	5.05	Presidential term$(t-4)$	Figure 26 (f)
	[2.51, 7.46]		
Positive diplomatic events	1.81	Autocorrelation	0.60
	[–1.26, 4.88]		[0.49, 0.70]
Positive personal events	0.85	(Intercept)	0.00
	[–3.41, 5.09]		[–0.26, 0.26]

Note: The 95% credible interval for the parametric estimate is in brackets.

Figure 24: Estimated effects on government consumption, two-stage estimation



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% pointwise credible intervals (dark and light grey areas respectively) and the 95% simultaneous credible interval (dash line).

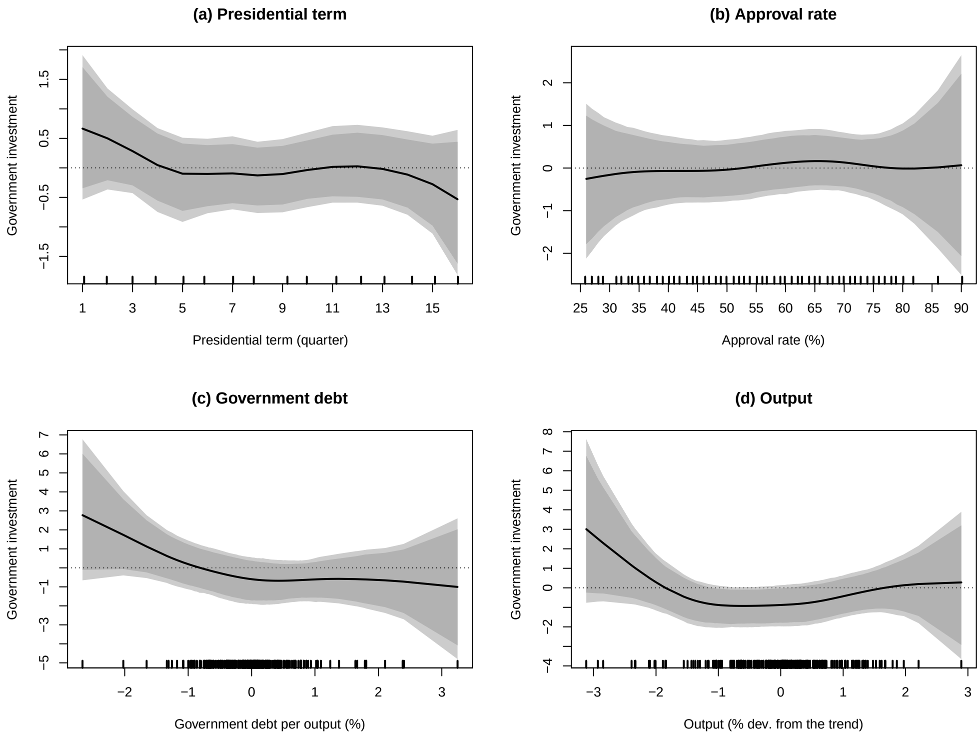
S.3.7 Other fiscal variables

Table 8: Estimation results

Covariate	Estimates			
	Government investment	Government transfers	Labor income tax rate	Capital income tax rate
Approval rate$(t-4)$	Figure 27 (a)	Figure 28(a)	Figure 29 (a)	Figure 30 (a)
Presidential term$(t-4)$	Figure 27 (b)	Figure 28 (b)	Figure 29 (b)	Figure 30 (b)
Government debt$(t-4)$	Figure 27 (c)	Figure 28 (c)	Figure 29 (c)	Figure 30 (c)
Output$(t-4)$	Figure 27 (d)	–	–	–
Output(t)	–	Figure 28 (d)	–	–
Hours worked(t)	–	–	Figure 29 (d)	–
Private investment(t)	–	–	–	Figure30 (d)
Autocorrelation	–0.02	0.74	0.63	0.63
	[–0.15, 0.11]	[0.69, 0.82]	[0.52, 0.73]	[0.53, 0.73]
(Intercept)	1.70	0.50	–0.19	–0.18
	[–0.10, 2.27]	[–0.69, 1.69]	[–0.32, –0.06]	[–0.40, 0.03]

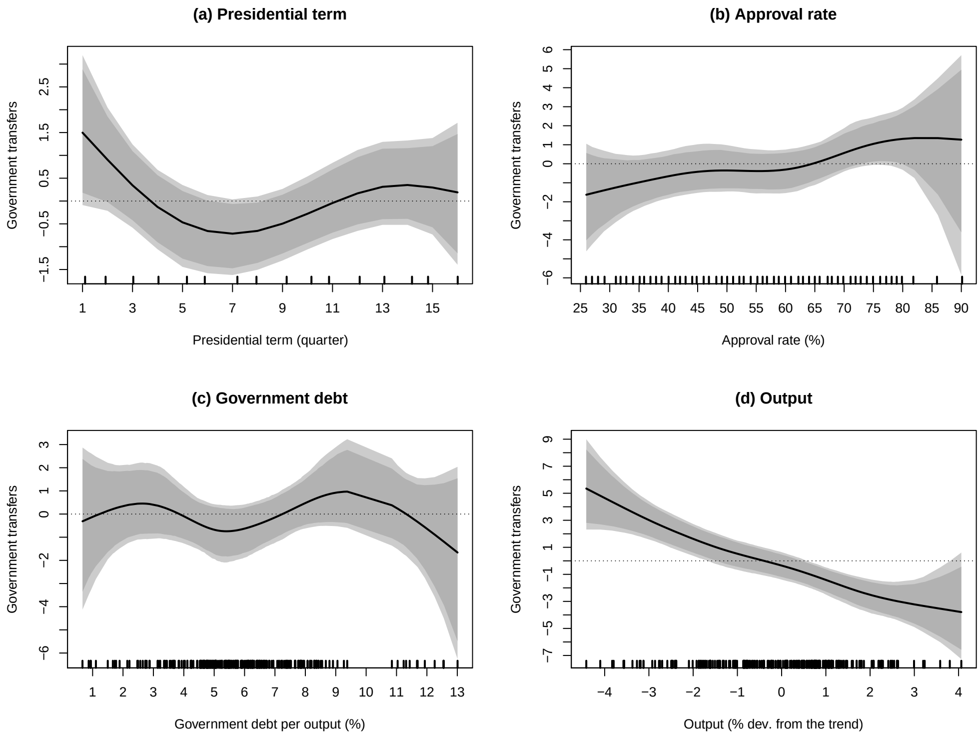
Note: The 95% credible interval is in brackets.

Figure 25: Estimated effects on government investment



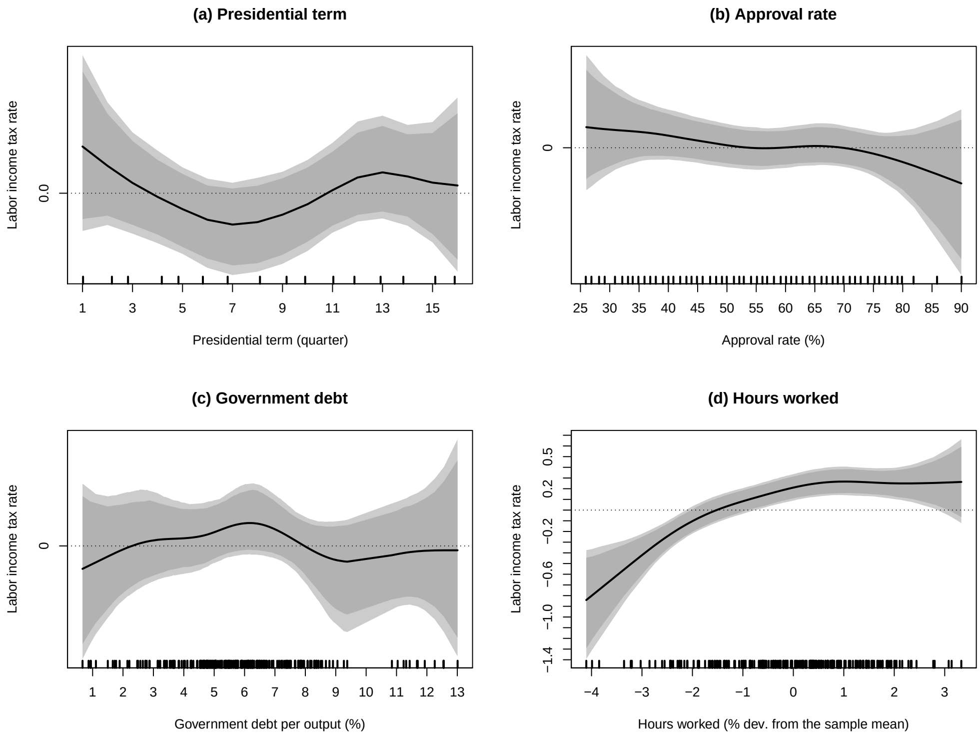
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 26: Estimated effects on government transfers



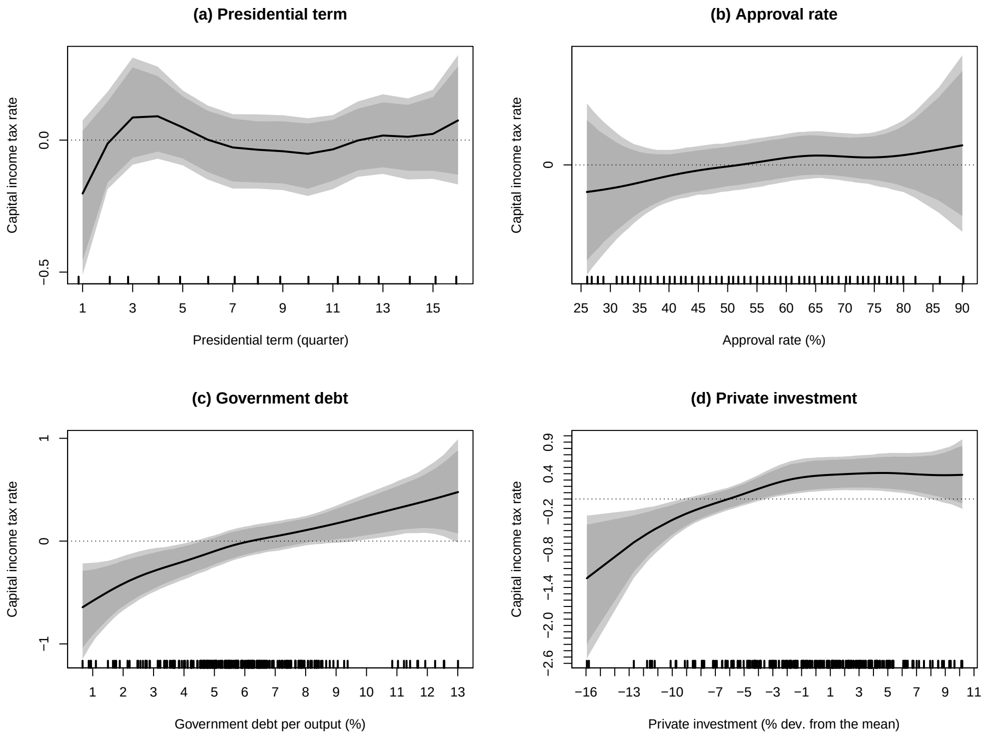
Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 27: Estimated effects on labor incoem tax rate



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).

Figure 28: Estimated effects on capital income tax rate



Notes: Solid black lines show estimated smooth curves in the model with 90 and 95% credible intervals (dark and light grey areas respectively).