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# Assigning Economic Policy and Business Cycle Shocks to Democrats and Republicans: A Common Trends Approach

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## Abstract

We estimate a so called common trends model of federal taxes and spending in the U.S.. Using dates on presidential terms as well as the NBER business cycle, we are able to interpret the estimated permanent shock as being of structural policy origin and the transitory shock as being of (to politicians) exogenous business cycle origin. Apart from strong partisan effects, we find that Republicans attempts to reduce the public sector during the first half of the term and that Republicans also have been unlucky to have been in office during the major part of the negative (exogenous) business cycle shocks.

**Keywords:** Fiscal policy; Democrats; Republicans; Partisan differences; Common trends.

**JEL Classification:** C32; E61; H11

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# 1 Introduction

In the structural vector autoregressive literature it is common to analyze the relative importance of structural shocks in explaining movements in specific variables at specific time periods. An early example Blanchard and Quah (1989) who calculate movements in GDP and unemployment due to structural demand and supply shocks and compare for example the time series of the structural demand shocks with business cycle dates published by NBER. A more recent example is Astley and Garratt (2000) who estimate a model of two countries including three variables (GDP and inflation differentials, and the real exchange rate) and identify three structural shocks (supply, demand, and money). They evaluate the relative importance of these shocks for explaining movements in the real exchange rate during the oil price shocks 1973-74 and 1979. In this paper, we carry out a methodologically related analysis when assigning permanent public sector and transitory business cycle shocks to Democratic and Republican terms during the post-war period in the U.S..

We estimate a so called common trends (CT) model including U.S. federal taxes and spending. As these two variables are found to be cointegrated, the CT model is driven by two structural shocks: one shock having permanent effects and one shock having only transitory effects on the fiscal variables. Previous empirical literature using CT models do not in general carry out any tests concerning the *nature* of the estimated structural shocks (Bergman et al., 2000, is an exception here).<sup>1</sup> Using information from data on presidential terms and business cycle dates, however, we are able to interpret the permanent shock as a policy induced 'economic policy shock' with significant partisan features and the transitory shock as a 'business cycle shock'<sup>2</sup>, respectively. This is arguably what we should expect when using a system of taxes and spending as it is (on our view) natural to believe that these variables should be driven by two types influences. First, structural political ambitions to increase or decrease the size of the public sector. One recent example of this is the tax cut of George W. Bush's administration. We would therefore expect there to be partisan differences when confronting the permanent shocks with Democratic and Republican terms as these two parties represent different ideologies. This is indeed confirmed in the paper. Second, spending and, to a much greater extent, taxes are affected by the business cycle through automatic stabilizers. As the economic policy shock and

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<sup>1</sup>Instead, based on economic theory, it is assumed that the shocks have a specific economic interpretation, e.g., being induced by shocks in technology, preferences, labor supply, economic policy or aggregate demand. Empirical applications of common trends models include (among others): Becker (1997, macroeconomic effects of fiscal policy), Bergman et al. (2000, PPP), Jacobson et al. (1998, real wages and unemployment), Hansson (2001, disposable income and private consumption), Mellander et al. (1992, GDP fluctuations), and Vredin and Warne (1991, current account and macroeconomic fluctuations).

<sup>2</sup>Of course, we could have labelled the temporary shock as a 'demand shock' with the same interpretation as the term we use: *business cycle shock*.

the transitory shock are identified to be orthogonal and as the economic policy shock is, as mentioned, interpreted to be policy induced (i.e., resulting from structural, discrete political decisions), the business cycle shock is exogenous to the politicians in our model. Using this fact, we test if Democrats or Republicans have been 'unlucky' to be in office during the major part of negative business cycle shocks. It turns out the Republicans have been very 'unlucky' in this respect. This is also confirmed by data on recessions published by NBER - Republicans have been in office during 27 out of 30 'recession quarters' since the second world war. We also test for timing differences concerning the structural shocks. One might think that the greatest partisan differences in the economic policy shock should appear during the first half of the term due to pre-election ideological promises. This prediction is confirmed in the paper.

To the authors knowledge, no political analysis like the one described above has been carried out before. The political economy literature has - both theoretically and empirically - focused on two lines of research. The so called *opportunistic* and *partisan* models of political behavior have dominated the area since the 1970s. Briefly, the opportunistic model assumes that politicians are office-motivated and that we therefore should observe pre-election booms (see Nordhaus, 1975, and Rogoff and Sibert, 1987). This has been widely tested and rejected by the majority of such studies.<sup>3</sup> The partisan models assume, on the contrary, that politicians are motivated by ideology.<sup>4</sup> According to these models, we would expect left-wing governments to care more about unemployment and growth than inflation. According to the majority of the empirical studies, the predictions of the partisan models are confirmed - output growth is higher during the first half of the term of left wing governments while inflation is permanently higher in both the U.S. and in the OECD countries.<sup>5</sup> Some studies have also tested if fiscal policy variables (taxes, spending, and the budget deficit) differ between right and left wing governments. Alesina et al. (1993) use a panel of OECD countries and find that left wing governments have significantly higher deficits while Alesina et al. (1997) find that Republicans pursue more expansionary fiscal policy.<sup>6</sup>

This paper could be said to be within the *partisan* literature above as we also focus on

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<sup>3</sup>See, among others, Alesina et al. (1993), Alesina et al. (1997), Golden and Poterba (1980), Haynes and Stone (1989) and Nordhaus (1989) for tests of the opportunistic model using monetary and fiscal policy variables without reflecting any partisan effects.

<sup>4</sup>The partisan model is originally due to Hibbs (1977). See also Hibbs (1987, 1992), Alesina, (1987, 1988) and Alesina and Sachs (1988) for extensions.

<sup>5</sup>For support of the 'rational' partisan models, see, among others, Alesina (1988), Alesina and Roubini (1992), Alesina et al. (1997), and Alesina and Sachs (1988). For support of the 'traditional' partisan model see, among others, Alt (1985), Beck (1982) and, Hibbs (1977). See Nordhaus (1989) for some contrary results.

<sup>6</sup>Alesina et al. (1997) show that Republicans have significantly greater increases in the cyclically adjusted debt ratio for the period 1948-1994 but this result vanishes if excluding the Reagan and Bush periods in the 1980s.

ideological differences. We do not evaluate, however, different macroeconomic outcome of Democrats and Republicans. Instead, as described above, we test: (i) if there is any partisan differences in the attempts to increase (decrease) the size of the public sector through structural political decisions, (ii) if Democrats or Republicans have been in office during the major part of the (to politicians) exogenous positive and negative business cycle shocks, and (iii) if there is any timing patterns concerning structural political decisions and business cycle shocks.

The main reason for looking at U.S. data is that the political system (only two parties and frequent shifts in power) is potentially favorable for detecting economic policy shocks compared to countries with many parties and/or less frequent shifts in power. More specifically, as the estimated permanent shocks are white noise by definition, these shocks could not be compared with something of deterministic nature. Elections as well as the specific ideology of the different presidents are (especially in the U.S.), however, stochastic events making the above mentioned comparison meaningful.

The paper is structured as follows. Section 2 presents the common trends model in brief while the identification and estimation procedure is outlined in the Appendix. Section 3 consists of the empirical analysis where we: (i) test for unit roots and cointegration, and (ii) interpret and assign the permanent and transitory shocks to Democrats, Republicans, and different parts of the presidential terms (first and second half as well as first, second, third, and fourth year). Section 4 concludes.

## 2 The Common Trends Model

The CT model presented below assumes that taxes ( $T$ ) and spending ( $G$ ) are cointegrated. This is tested and confirmed in section 3.1. As we have two variables and one cointegrating relation, our CT model is driven by one shock having permanent effects and one shock having temporary effects on the two variables. King et al. (1987, 1991) were the first to examine the relationship between the concepts of cointegration and common trends and Warne (1993) has further developed the CT representation including asymptotic distributions of the impulse response functions. Below we present the applied CT model in brief giving the necessary information for understanding the ideas considered in the paper while the Appendix gives the details concerning identification and estimation.

Following Warne (1993), the structural CT model can be described as:

$$x_t = x_0 + \Upsilon\tau_t + \Phi(L)\nu_t, \quad (1)$$

where  $x'_t = \begin{bmatrix} T_t & G_t \end{bmatrix}$ ,  $\Phi(\lambda) = \sum_{i=0}^{\infty} \Phi_i \lambda^i$  is finite for  $|\lambda| \leq 1$  which implies that  $\Phi(L)\nu_t$  is stationary. Hence, the  $2 \times 1$  vector of structural shocks,  $\nu_t$  ( $E[\nu_t] = 0$ ), have only temporary effects on  $x_t$ .  $\tau_t$  is the single common trend and is described as an unit root process:

$$\tau_t = \mu + \tau_{t-1} + \varphi_t, \quad (2)$$

where  $\varphi_t$  is the shock having permanent effect on the variables in the model and it is assumed that  $E[\varphi_t] = 0$ . Solving (1) with respect to (2) we get:

$$x_t = x_0 + \Upsilon \left[ \tau_0 + \mu t + \sum_{j=1}^t \varphi_j \right] + \Phi(L)\nu_t, \quad (3)$$

where:

$$x_t^T = x_0 + \Phi(L)\nu_t, \quad (4)$$

is the transitory (stationary) part and:

$$x_t^P = \Upsilon \left[ \tau_0 + \mu t + \sum_{j=1}^t \varphi_j \right], \quad (5)$$

is the permanent part. The model has, as mentioned, two structural shocks.  $\varphi_t$  is assumed to have both permanent (see (5)) and temporary ( $\nu_t' = \begin{bmatrix} \varphi_t & \psi_t \end{bmatrix}$  in (4)) effects on  $x_t$ .  $\psi_t$  is the temporary shock and is only included in  $\nu_t$  and has hence only temporary effects on  $x_t$ . These shocks are identified by the following relationships (see Appendix):

$$\varphi_t = (\gamma'_\perp \Sigma \gamma_\perp)^{-1/2} \gamma'_\perp \varepsilon_t, \quad (6)$$

and:

$$\psi_t = (\gamma' \Sigma^{-1} \gamma)^{-1/2} \gamma' \Sigma^{-1} \varepsilon_t, \quad (7)$$

respectively, where  $\gamma$  is a  $2 \times 1$  vector of the short run adjustment parameters,  $\Sigma$  is the variance-covariance matrix and  $\varepsilon_t$  are the residuals - all stemming from the underlying vector error correction model. As shown in the Appendix, only two restrictions are needed in order to identify these shocks: (i) the cointegration relationship of the two variables - we use the empirical relationship, see section 3.1 below and, (ii) permanent and transitory shocks are assumed to orthogonal.

The outlined CT model is the basis of the empirical analysis in the paper. In section 3.2 we confront the two shocks in (6) and (7) with data on presidential terms and business cycle dates, respectively.  $\Upsilon\mu$  in (5) represents the average quarterly growth in the permanent part of spending and taxes. In our empirical estimation,  $\Upsilon\mu$  corresponds to a yearly growth of about 1.8 (2.1) percent in per capita permanent taxes (spending). This average growth is a combined estimate which includes the policies pursued by both parties and can, for example, be explained by real increases in payments of governments employees as well as transfer limits (in order to keep track with the payments in the private sector), increased costs for consumption and investments due to new products with quality improvements, and increase in the scope of government responsibilities agreed upon by both parties. We can note that the estimated growth in these variables is close to the growth in the U.S. economy as a whole - about 2.0 percent per capita.

Apart from  $\Upsilon\mu$ , we assume that the political parties (Democrats and Republicans) try to pursue ideological policies appearing in the data as the permanent shocks,  $\varphi_t$ . These

shocks cancel out over the estimation period ( $\sum_{j=1}^t \varphi_j$ , the shocks are white noise by definition) and we believe that this is a realistic description of the real political context in the U.S. post-war history with two different ideologies (Democrats and Republicans) and a frequent shift in power. As the series of permanent shocks is white noise, no deterministic variable will be associated with it. However, as elections as well as the specific ideologies of presidents are stochastic, we expect Democrats to be responsible for the major part of the positive permanent shocks attempting to increase the permanent size of the public sector due to ideological reasons. This is tested and confirmed in section 3.2.1 below.

Finally, it is important to note that the transitory shock ( $\psi_t$ ) is identified to be orthogonal to the permanent shock. As the permanent shock is interpreted as a policy induced shock and the transitory shock is interpreted as a business cycle shock, our model implies that the business cycle shock is exogenous to politicians. It is therefore meaningful and, arguably, interesting to evaluate if Democrats or Republicans have been in office during the major part of the positive (negative) business cycle shocks.

## 3 Empirical Analysis

### 3.1 Tests of Unit Roots and Cointegration

Our CT model with taxes and spending outlined above assumes that the two time series are stochastically nonstationary and cointegrated. We begin therefore to test for unit roots and cointegration. We use data on federal spending (consumption, investments and transfers) and taxes.<sup>7</sup> The data used is displayed in the top panel of Figure 1.<sup>8</sup> Both federal spending and taxes display an upward trend over the period. By looking at the lower left panel of Figure 1, it is evident that spending has, with a few exceptions, been greater than taxes - i.e., a permanent federal government deficit which can not be devoted to business cycle fluctuations but rather to political decisions. It is also important to note that the deficit seems to have been increasing over the period. By eye-balling the down-left graph, it appears like deficit ( $T - G$ ) is not stationary. This is confirmed below as we reject the presence of a  $\begin{pmatrix} 1 & -1 \end{pmatrix}$  cointegrating vector.

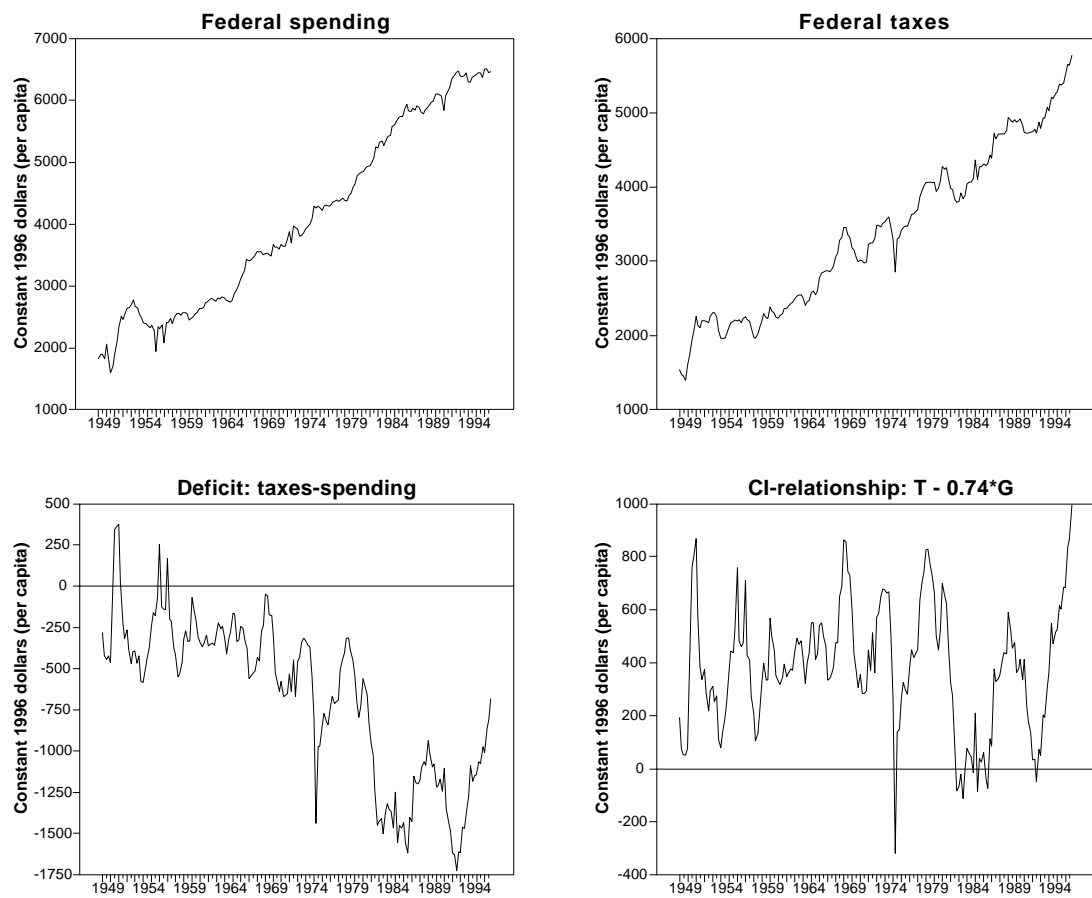
Both the unit root and the cointegrating tests are performed within Johansen's (1995) multivariate cointegration framework. As can be seen in Table 1, we can clearly reject that the two variables are stationary and trend stationary. When testing if the variables

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<sup>7</sup>The reason for just including the federal government is of course that we aim to analyze partisan differences in fiscal policy. Including state and local governments would therefore be too complicated.

<sup>8</sup>Quarterly data on federal taxes and spending is applied - all taken from the National Income and Product Accounts. All data is per capita, fixed 1996 prices, and seasonally adjusted by source. The data begins in 1949:1 when H.S. Truman started his term and ends in 1996:4 when W.J. Clinton ended his first term.

Figure 1: Federal spending, taxes, budget deficit, and the estimated cointegrating relationship





are cointegrated, we specify a vector error correction model:<sup>9</sup>

$$A^*(L)\Delta x_t = \rho + D_t - A(1)x_{t-1} + \varepsilon_t, \quad (8)$$

where  $A_i^* = -\sum_{j=i+1}^{p-1} A_j$ ,  $A_j$  being the matrices of vector autoregressive (VAR) parameters<sup>10</sup> and  $A(1) = -\gamma\alpha'$  where  $\alpha$  is the cointegration vector and  $\gamma$  are the adjustment coefficients.  $p$  is the lag length of the underlying VAR model, chosen to five in order to remove autocorrelation.<sup>11</sup>

$D_t$  is a dummy variable that equals one in war periods. The reason for including this dummy is that it captures the abnormal spending (and to some extent) tax increases during war times which otherwise would (mainly) appear in the time series of permanent (public sector) shocks as they are policy induced - the sum of the permanent shocks during war periods is approximately zero when including the war dummy while being positive and of substantial magnitude if excluding the dummy. Although the *permanent* shocks are interpreted to be policy induced, we believe that it is reasonable to control for war periods as these are, more or less, exogenous. Most importantly, however, the results shown in the paper concerning cointegration relationships and partisan differences in the permanent and transitory shocks are not affected to any important extent.<sup>12</sup> Finally we can note that Democrats (Republicans) have been in office during 26 (28) out of 54 war quarters during the period.<sup>13</sup>

As we include a dummy in our estimation, the asymptotic distribution of the Trace test is not valid (see, e.g., Doornik et al., 1998). We therefore use a bootstrap approach to find empirical critical values and it turns out that these are very close to the asymptotic values.<sup>14</sup> We can reject  $H_0$  (no cointegration,  $r = 0$ ) at the 5% level. We can note that our empirical long run cointegrating vector,  $\alpha'$ , equals  $\begin{pmatrix} 1 & -0.74 \end{pmatrix}$  while the vector

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<sup>9</sup>Using the Pantula (1989) principle for, arguably, the two most realistic models: (i) unrestricted constant and, (ii) trend in the cointegration space, the former model was chosen.

<sup>10</sup>The underlying vector autoregressive model is:

$$A(L)x_t = \rho + \varepsilon_t,$$

where  $A(\lambda) = I_2 - \sum_{i=1}^p A_i \lambda^i$  satisfies  $\det[A(\lambda)] = 0$  if and only if  $|\lambda| \geq 1$  where  $\lambda$  are the eigenvalues. Hence, we allow for unit roots but not explosive roots.

<sup>11</sup>Starting with eight lags and testing down, Lagrange multiplier tests selected five lags as the most parsimonious model with no autocorrelation. A lag length of two also passed the Lagrange multiplier tests and implied one cointegrating vector. This lag length implied, however, that several significant 'spikes' in the correlogram of the residuals were present. Five lags is therefore applied in the paper.

<sup>12</sup>Parallel results when not using the dummy can be received from the author on request.

<sup>13</sup>The war periods are: 1950:2-1953:3 (Korea) and 1965:1-1975:1 (Vietnam). Note that we do not want to exclude military spending *totally* in our analysis as it might be an important variable in which the two parties differ.

<sup>14</sup>We bootstrap the Trace statistic under two possible cointegration ranks;  $r = 0, r \leq 1$  (see Giersbergen, 1996, and Jacobson et al., 1998, for similar applications). For example, in the case of  $r \leq 1$ :

Table 1: Test of stationarity and cointegration using the Johansen approach

| $H_0$ :    | Trace  | Bootstrap |
|------------|--------|-----------|
| $r = 0$    | 17.26* | 15.88     |
| $r \leq 1$ | 0.82   | 3.43      |

|          | Stationarity | Trend stationarity | Long run vector [1, -1] |
|----------|--------------|--------------------|-------------------------|
| Taxes    | 0.00         | 0.03               |                         |
| Spending | 0.00         | 0.00               |                         |
|          |              |                    | 0.00                    |

*Note:* The trace test concerns the rank decision when estimating equation (8). The empirical critical value is based on the bootstrap of the Trace test described in footnote 14. '\*' denotes significance at the 5% level. P-values are shown for the stationarity tests and the test of the  $\begin{pmatrix} 1 & -1 \end{pmatrix}$  vector (the null hypothesis is stationarity and  $\begin{pmatrix} 1 & -1 \end{pmatrix}$ , respectively, and hence rejected).

$\begin{pmatrix} 1 & -1 \end{pmatrix}$  is rejected and we will therefore apply the estimated vector in the CT estimation below.<sup>15</sup> The estimated cointegrating relationship is shown in the down-right graph of Figure 1 and looks indeed stationary.

- 1) We estimate the VEC model under the  $r \leq 1$  hypothesis and save the parameters and the residuals.
- 2) We generate a new residual series (transformed according to the estimated covariance matrix),  $\tilde{\epsilon}_t$ , by drawing randomly with replacement from the estimated residuals,  $\hat{\epsilon}_t$ . Then we calculate:

$$\Delta \hat{\mathbf{x}}_t^* = \hat{\boldsymbol{\mu}} + \hat{\mathbf{\Gamma}}_1 \Delta \mathbf{x}_{t-1}^* + \dots + \hat{\mathbf{\Gamma}}_p \Delta \mathbf{x}_{t-p}^* + \hat{\mathbf{\Pi}} \mathbf{x}_{t-1}^* + \tilde{\epsilon}_t$$

- 3) The VEC model is then re-estimated using  $\Delta \hat{\mathbf{x}}_t^*$ .
- 4) Re-calculate the Trace statistic for  $r \leq 1$ . Step 2-4 is repeated 5000 times.

For each simulation, we calculate the Trace statistic for  $r \leq 1$  and at the end we apply the percentile method (Efron and Tibshirani, 1993) to get the 95 % critical values for  $r \leq 1$ . The above procedure was also applied to  $r = 0$ . See Table 1 for the empirical critical values of the Trace test.

<sup>15</sup>The empirical cointegrating vector clearly violates the long run intertemporal budget constraint of the government. As we have a limited sample of 47 years (188 quarters), we believe it is more interesting to consider the development of the debt ratio (here defined as federal debt divided by GNP) in order to say something about sustainability of the debt. In 1949 (i.e. after the war), the ratio was 0.97 and, inspite of the permanent deficit shown in Figure 1, the ratio has *decreased* to 0.64 in 1996. Hence, the steady increase in the federal debt implied by the estimated cointegrating vector falls short in the increase of GNP over the time period.

We also believe that it is natural to stop in the end of Clinton's first period (1996:4) as it might be a structural break in the deficit series in the middle of 1990s. The political debate was then very focused on a 'balanced budget' making it hard for any president to run deficits. The future will show if this indeed is the case.

## 3.2 Economic Interpretation of Structural Shocks<sup>16</sup>

As discussed in the introduction, most studies using CT models assume (based on economic theory) the interpretation of the structural shocks. In order to evaluate partisan differences, we confront the estimated structural shocks with real data. Of course, there are potentially an infinite number of variables that could be tested to be correlated with these shocks. However, as argued in the introduction, economic sense suggests that movements in fiscal variables should be driven by structural political decisions as well as business cycle fluctuations. Below we test if this interpretation is confirmed using data on Democratic and Republican terms as well as business cycle dates from NBER.

### 3.2.1 Permanent Shocks and Presidential Terms

Referring back to the derivation of the CT model in section 2, a positive permanent shock ( $\varphi_t > 0$ ) implies an increase in the permanent part of both taxes and spending as the signs of the coefficients in the 'loading matrix',  $\Upsilon$ , are both positive (see equation (5)). It is well known that Democrats and Republicans represent two different ideologies. In particular, we would expect Democrats to decide to increase the structural (permanent) parts of both taxes and public spending while the opposite is true for Republicans. One might also suspect that the partisan differences are greatest in the beginning of the presidential term as the presidents try to fulfill their pre-election ideological promises.<sup>17</sup>

Figure 2 shows the permanent shocks during Democratic and Republican terms. The upper panel concerns the whole terms and it appears like the permanent shocks are mostly positive (negative) during Democratic (Republican) terms. The partisan differences are, however, most apparent when considering the first half (first two years, see the mid panel) of the term. The majority of the permanent shocks during the first half of the Republican terms are clearly negative while most of the shocks are positive during both the first and the second half of the Democratic terms. Finally we can note that the partisan differences during the second half of the term (bottom panel) appear small.

In Table 2 we test for partisan differences in permanent shocks during: (i) the whole term, (ii) the first and second half of the term, and (iii) the first, second, third, and fourth year of the term. Beginning with the first two columns in the top panel of Table 2, we can note that the sum of the permanent shocks during Democratic (Republican) terms is 11.96 (−11.96).<sup>18</sup> The difference arises from differences during the first half of the term - the sum of the permanent shocks during the first two years of Democratic (Republican) terms is 4.51 (−14.49) and the partisan difference is significant (t-test: 2.30, critical value

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<sup>16</sup>The RATS code for the CT program applied is written by Henrik Hansen and Anders Warne.

<sup>17</sup>The extensive tax cut in the beginning of G.W. Bush's present presidential term is a recent support of this argument.

<sup>18</sup>A permanent shock of magnitude one ( $\varphi_t = 1$ ) implies a 1.7% quarterly growth of permanent taxes and 1.9% growth of permanent spending as  $\hat{\Upsilon}' = \begin{bmatrix} 56.8 & 78.1 \end{bmatrix}$  in (5).

Figure 2: Permanent public sector shocks during Democratic and Republican governments: total (upper panel); first two years of the term (mid panel); last two years of the term (bottom panel)

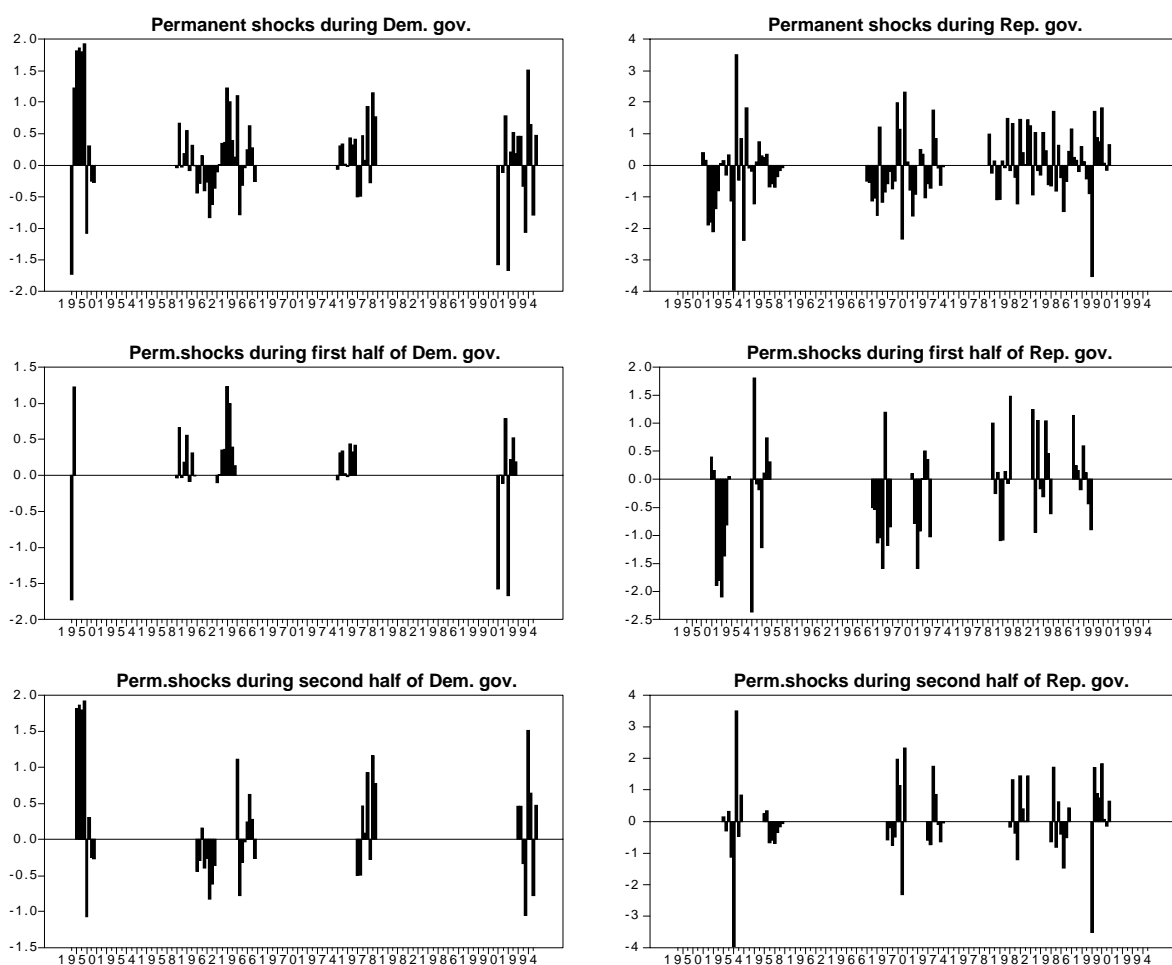


Table 2: Test of partisan differences of the estimated permanent shocks

|                     | DEM<br>Total | REP<br>Total | DEM<br>Mean(s.e.) | REP<br>Mean(s.e.) | Test of<br>equality |
|---------------------|--------------|--------------|-------------------|-------------------|---------------------|
| <b>Whole period</b> | 11.96        | -11.96       | 0.16**(0.09)      | -0.11(0.11)       | 1.95                |
| <b>First half</b>   | 4.51         | -14.49       | 0.13(0.11)        | -0.26*(0.13)      | 2.30                |
| <b>Second half</b>  | 7.45         | 2.53         | 0.19(0.13)        | 0.05(0.17)        | 0.66                |
| <b>First year</b>   | 1.08         | -8.07        | 0.07(0.13)        | -0.29(0.19)       | 1.54                |
| <b>Second year</b>  | 3.43         | -6.42        | 0.19(0.19)        | -0.23(0.17)       | 1.65                |
| <b>Third year</b>   | 5.51         | -2.15        | 0.28(0.21)        | -0.08(0.21)       | 1.19                |
| <b>Fourth year</b>  | 1.94         | 4.68         | 0.10(0.16)        | 0.17(0.27)        | 0.20                |

*Note:* 's.e.'=standard error of the sample mean. '\*\*','\*\*\*' denote significant difference from zero (at the 5, 10% level). 't-value': test of the equality of DEM and REP mean values - the test is described in footnote 19. The 95 (90) percent critical value for this test differ depending on the degrees of freedom but is close to 2.0 (1.67) in the cases we consider.

2.0).<sup>19</sup> By comparing the permanent shocks during the first and second halves of the term, it is clear that Democratic policies do not differ that much while Republicans pursue very different policies - reducing the public sector to a great extent during the first half while then increasing it more moderately during the second half.

Finally, when dividing the presidential terms into the first, second, third, and fourth year, it is clear that the partisan difference arise mainly due to differences during the first and second year in office. This is in line with the prior belief that partisan differences should be greatest during the first part of the presidential terms due to pre-election ideological promises. We can also note that in the fourth year (i.e., in the election year),

<sup>19</sup>In this significance test, a small sample test for difference between two population means have been applied (see Aczel, 1989):

$$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}, \quad df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}}$$

where  $\bar{x}_i, s_i^2, n_i$ ,  $i = 1, 2$ , are the sample mean, variance and the number of observations, respectively. The small sample adjusted degrees of freedom ( $df$ ) is adjusted downward if not an integer. In all our tests, the critical values are approximately 2.0 (1.67) for the 5% (10%) significance level.

the sum of the Republican is positive while being negative in the first, second, and third year.

In conclusion it can be said that Democrats are responsible for the majority of the decisions to increase the size of the public sector while Republicans seem to try to reduce it and that the partisan differences stem from the first two years of the term. Based on the results in this section, we believe that the estimated permanent shock can be interpreted as an *economic policy shock* (or public sector shock) as we have found the partisan and timing differences to go in the expected direction.

### 3.2.2 Temporary Shocks and Business Cycles

Business cycles are, by definition, a temporary phenomenon. It is therefore tempting just to assume that the temporary shock is a 'business cycle shock' (or, equally, an 'aggregate demand shock'). This assumption is first tested in this section and then we test for partisan differences concerning the transitory shocks.

We carry out two tests (one informal and one formal) in order to see if the transitory shock can be interpreted as a business cycle shock. In the first of these 'tests', we simply examine the impulse response of taxes and spending to a transitory shock. *If* such a shock can be labelled as a business cycle shock, we would expect taxes and spending to go in opposite direction as a response to such a shock - taxes are (strongly) procyclical due to the close relationship with GDP and spending are (slightly) countercyclical due to (foremost) the workings of the transfer systems. By looking at Figure 3, our intuition about the nature of transitory shocks appears to be correct - taxes and spending goes in the opposite direction. As taxes respond negatively and spending positively, a *positive* transitory shock can be interpreted as a *negative* business cycle shock.

In order to support this result, we test if the transitory shocks occurring during recession periods (as defined by NBER) are significantly different from those occurring during non-recession periods.<sup>20</sup> By inspecting the first and second panel of Figure 4, it is clear that the transitory shocks indeed are closely associated with the business cycle. With a few exceptions, recession periods are associated with positive transitory shocks (see the first panel of Figure 4). The mean of the transitory shocks during recession and non-recession periods is 0.57 and  $-0.11$ , respectively and the difference is highly significant (t-value: 4.65 using the test described in footnote 19). Based on the results in Figures 3 and 4, we interpret a positive transitory shock as a negative business cycle shock.

Now we turn to partisan differences in the transitory shocks. It is important to remember that structural political decisions (which are represented by the permanent shocks) are orthogonal to the transitory (business cycle) shock. Hence, the transitory shock is exogenous to politicians in our model. In the following we examine whether Democrats

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<sup>20</sup>The 'recession quarters' are (according to NBER): 1953:3-1954:2, 1957:4-1958:2, 1960:3-1961:1, 1970:1-1970:4, 1974:1-1975:1, 1980:1-1980:2, 1981:3-1982:4, and 1990:3-1991:1.

Figure 3: Tax and spending response to a transitory shock

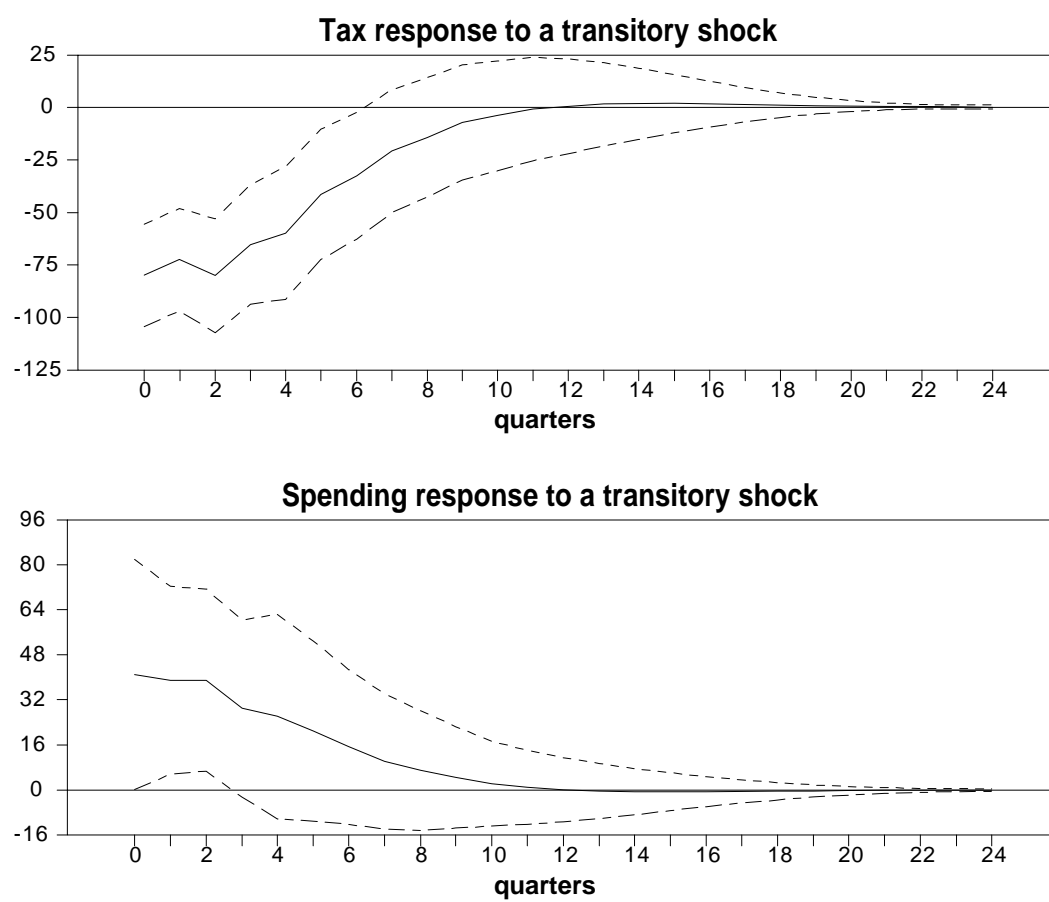


Figure 4: Transitory shocks during (NBER) recession periods (first panel), non-recession periods (second panel), Democratic terms (third panel), and Republican terms (fourth panel)

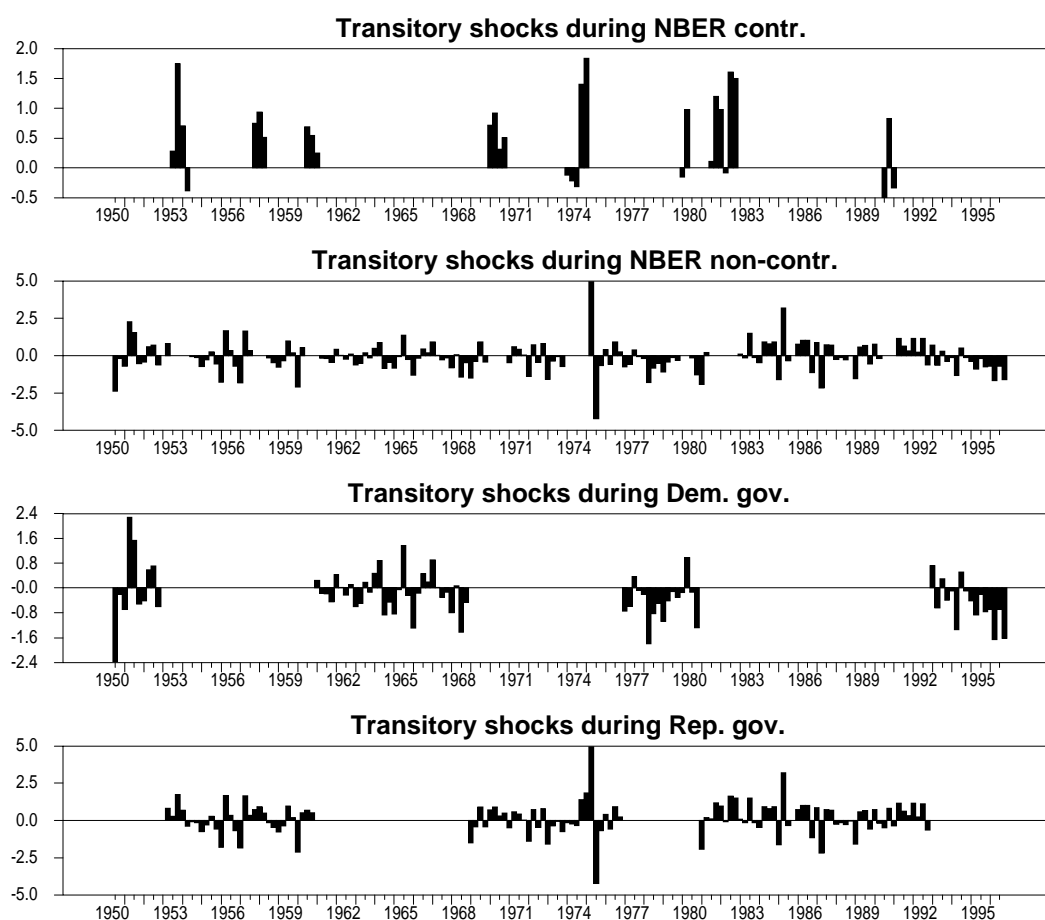




Table 3: Test of partisan differences of the estimated temporary shocks

|                     | DEM<br>Total | REP<br>Total | DEM<br>Mean(s.e.) | REP<br>Mean(s.e.) | Test of<br>equality |
|---------------------|--------------|--------------|-------------------|-------------------|---------------------|
| <b>Whole period</b> | -18.40       | 18.40        | -0.25*(0.09)      | 0.16(0.10)        | 3.01                |
| <b>First half</b>   | -8.76        | 10.42        | -0.26*(0.12)      | 0.19(0.13)        | 2.45                |
| <b>Second half</b>  | -9.64        | 7.97         | -0.24**(0.13)     | 0.14(0.16)        | 1.85                |
| <b>First year</b>   | -1.36        | -0.29        | -0.08(0.15)       | -0.01(0.23)       | 0.28                |
| <b>Second year</b>  | -7.40        | 10.72        | -0.41*(0.19)      | 0.38*(0.13)       | 3.43                |
| <b>Third year</b>   | -2.10        | 4.54         | -0.10(0.18)       | 0.16(0.28)        | 0.80                |
| <b>Fourth year</b>  | -7.54        | 3.43         | -0.38*(0.18)      | 0.12(0.17)        | 2.01                |

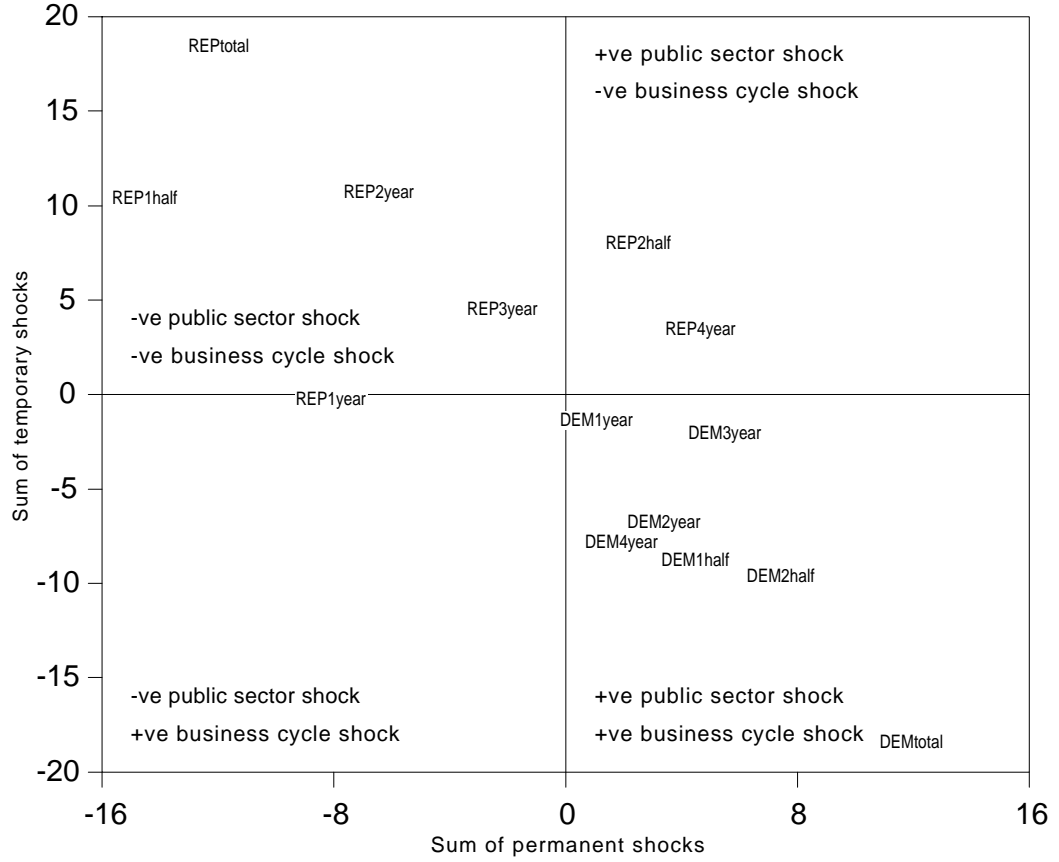
*Note:* 's.e.'=standard error of the sample mean. '\*\*','\*\*' denote significant difference from zero (at the 5, 10% level). 't-value': test of the equality of DEM and REP mean values - the test is described in footnote 19. The 95 (90) percent critical value for this test differ depending on the degrees of freedom but is close to 2.0 (1.67) in the cases we consider

or Republicans have been 'unlucky' to be in office during the major part of the positive transitory shocks (which were interpreted as negative business cycle shocks above). By inspecting panels three and four in Figure 4, it is rather clear that *Republicans* have been unlucky in this respect.

Table 3 shows some tests of partisan differences of the temporary shocks. Beginning with the whole period, the sum of the temporary shocks during Democratic and Republican terms is  $-18.40$  and  $18.40$ , respectively, and the difference is statistically significant: t-value 3.01 (critical value 2.0, see footnote 19). We can also note that the partisan differences stem from both the first and second half of the term. When splitting the period into first, second, third, and fourth year, it is evident that the significant difference between the two parties stems foremost from the second and fourth year. It is worth to emphasize that, in terms of business cycle shocks, Democrats have been much more lucky during election years:  $-7.54$  compared to  $3.43$  for Republicans, and the difference is significant (t-value: 2.01).

In conclusion it can be said that Republicans indeed have been in office during the majority of the positive transitory shocks which implies, according to Figures 3 and 4, that their terms have been associated by negative business cycle shocks. This is supported by data on NBER's recession periods as Republicans have been in office during 27(!) out

Figure 5: Summary of results: Sum of permanent and transitory shocks during Democratic and Republican governments



of 30 recession quarters since the second world war.

We end this section by showing a figure that summarize and (hopefully) clarify the results of the paper. More specifically, we put the results concerning economic policy (permanent) and business cycle (transitory) shocks during Democratic and Republican terms (displayed in Tables 2 and 3) together, see Figure 5. As can be seen in the figure, most of the reference points for Republican terms are in the upper left quadrant implying political decisions to lower the size of the public sector and negative (for politicians, exogenous) business cycle shocks.<sup>21</sup> All of the reference points for Democratic terms are instead in the lower right quadrant implying political decisions to increase the public sector and positive business cycle shocks.

<sup>21</sup>Note that the negative business cycle shocks correspond to positive transitory shocks, see discussion in section 3.2.2.

## 4 Conclusions

In this paper we have analyzed the U.S. federal fiscal policy within a common trends framework. As the included variables (taxes and spending) are cointegrated, the model is driven by one permanent and one transitory shock. The permanent shock is interpreted to be induced by politicians and the temporary shock (exogenous to political decisions in our model) is interpreted to be induced by the business cycle.

Although our model (as any model) is a simplification of reality, it does conform to what we would expect in several respects. First, we find that Democrats are responsible for the major efforts to increase the permanent size of the public sector. Second, we find that Republicans have been in office during the majority of the (to politicians exogenous) negative business cycle shocks which supports the fact that Republicans actually have been in office during 27 out of 30 'recession-quarters' published by NBER. Third, we find that war periods are associated with positive permanent sector shocks.

Apart from these results, several other results emerge from the analysis. We show that the partisan differences in the conduct of fiscal policy stem from differences during the *first half* of the term. While the permanent shocks during the first and second half of Democratic terms are similar, the permanent shocks are significantly negative during the first half of Republican terms. This implies that Republicans try to reduce the size of the public sector closely after the election and this pattern is arguably due to pre-election (ideological) promises by the Republicans. We also show that partisan differences in the transitory (business cycle) shock stems from the second and fourth year of the term. Most importantly, Republicans have been unlucky to have been in office during election years when negative business cycle shocks (exogenous to politicians) have hit the economy while the opposite is true for Democrats.

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## Appendix: Identification and Estimation of the CT Model

As common trends models not have been applied within this area of research, we describe the details of identification and estimation of the structural common trends model. Although the algebra might look messy at times, our model with two variables implies, as will be shown below, that very few restrictions must be imposed in order to identify the system. First, we need the cointegration restriction which was empirically confirmed in section 3.1. Second, we assume that permanent and temporary shocks are uncorrelated and, finally, we normalize the transitory shocks so that they have unit variance.

Similar applications using two variables include Bergman et al. (2000) and Hansson (2001) and the presentation below follows Warne (1993) closely.

### Relationship Between Structural and Reduced Form CT Model

First we derive the relationship between the structural CT model shown in (3) and the reduced form counterpart. We start with the vector autoregressive (VAR) model:

$$A(L)x_t = \rho + \varepsilon_t,$$

where  $A(\lambda) = I_2 - \sum_{i=1}^p A_i \lambda^i$  satisfies  $\det[A(\lambda)] = 0$  if and only if  $|\lambda| \geq 1$ ,  $\lambda$  being the eigenvalues of  $A(L)$  (see, e.g., Lütkepohl, 1993). Hence, we allow for unit roots but not explosive roots. Using the Granger Representation Theorem (GRT, see Engle and Granger, 1987) we can rewrite a VAR model as a vector error correction (VEC) model:

$$A^*(L)\Delta x_t = \rho - \gamma z_{t-1} + \varepsilon_t, \quad (\text{A.1})$$

where  $z_{t-1} = \alpha' x_{t-1}$  and  $A_i^* = -\sum_{j=i+1}^{p-1} A_j$  for  $i = 1, \dots, p-1$ .  $\gamma$  is a matrix of parameters that tells us how  $\Delta x_t$  adjusts to last periods equilibrium error. Since  $\Delta x_t$  is stationary (i.e., the variables in  $x_t$  are I(1) as shown in section 3.1), GRT further implies the presence of a vector moving average representation of (A.1):

$$\Delta x_t = \delta + C(L)\varepsilon_t, \quad (\text{A.2})$$

where  $C(\lambda) = I_2 + \sum_{j=1}^{\infty} C_j \lambda^j$ . As shown by Stock (1987),  $C(\lambda) = C(1) + (1 - \lambda)C^*(\lambda)$  where  $C(1) = \sum_{i=0}^{\infty} C_i$ ,  $C_i^* = -\sum_{j=i+1}^{\infty} C_j$ , and  $C^*(\lambda) = \sum_{i=0}^{\infty} C_i^* \lambda^i$  is absolutely summable.  $C(1)$  has rank one in our system and  $\alpha' C(1) = 0$ . If we substitute the expression for  $C(\lambda)$  recursively into (A.2) we get:

$$x_t = x_0 + C(1)\xi_t + C^*(L)\varepsilon_t, \quad (\text{A.3})$$

where  $\xi_t = \rho + \xi_{t-1} + \varepsilon_t$  and  $\delta = C(1)\rho$ . Solving (A.3), we get the *reduced form* CT model:

$$x_t = x_0 + C(1) \left[ \xi_0 + \rho t + \sum_{j=1}^t \varepsilon_j \right] + C^*(L)\varepsilon_t,$$

where the relationship with the *structural* CT model in (3) is:

$$\Upsilon\varphi_t = C(1)\varepsilon_t, \quad \Upsilon\Upsilon' = C(1)\Sigma C(1)', \quad \Upsilon\mu = C(1)\rho. \quad (\text{A.4})$$

## The Restricted VAR Model and Identification of Structural Shocks

We need estimates of  $C(1)$  and  $\Sigma$  in order to get hold of estimates of  $\Upsilon$  in (A.4). We can either invert the VEC model in (A.2), suggested by Stock and Watson (1988), or invert the restricted VAR (RVAR) model, suggested by Campbell and Shiller (1988) for the two variable case and generalized by Warne (1993). Here we follow the latter alternative and estimate the RVAR model and show the methodology for the general case. The RVAR equals:

$$B(L)y_t = \theta + \eta_t, \quad (\text{A.5})$$

where  $y_t = D_\perp(L)Mx_t$ .<sup>22</sup> Based on the estimated cointegrating vector (see section 3.1), the  $y_t$  vector of variables in the RVAR therefore equals:  $\begin{bmatrix} \Delta T_t & T_t - 0.74 * G_t \end{bmatrix}$ , i.e. the first difference of the first variable and the cointegrating relationship. Moreover,  $B(L) = M[A^*(L)M^{-1}D(L) + \gamma^*L]$ .<sup>23</sup> From the estimates of the RVAR system in (A.5) there are the following relationships to the variables we need, i.e.  $C(1)$  and  $\Sigma$ :

$$\begin{aligned} C(1) &= M^{-1}D(1)B(1)^{-1}M \\ \Sigma &= M^{-1}E[\eta_t\eta_t'](M')^{-1} \end{aligned} \quad (\text{A.6})$$

The final step is to identify the permanent ( $\varphi_t$ ) and transitory ( $\psi_t$ ) shocks contained in the vector of structural innovations,  $\nu_t$  (see (3)). That is, we need a matrix  $\Gamma$  to transform the reduced form innovations,  $\varepsilon_t$ , into the structural counterparts:

$$\begin{bmatrix} \varphi_t \\ \psi_t \end{bmatrix} = \begin{bmatrix} \Gamma_k \\ \Gamma_r \end{bmatrix} \varepsilon_t,$$

where  $\Gamma_k$  and  $\Gamma_r$  identify the permanent and transitory shocks, respectively. We know from (A.4) above that the relationship between the structural and reduced form CT model implied that  $\Upsilon\varphi_t = C(1)\varepsilon_t$ . Hence, the structural shocks equals:

$$\begin{aligned} \varphi_t &= (\Upsilon'\Upsilon)^{-1}\Upsilon'C(1)\varepsilon_t \\ &= \Gamma_k\varepsilon_t. \end{aligned} \quad (\text{A.7})$$

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<sup>22</sup>  $D_\perp(L) = \begin{bmatrix} (1-L)I_k & 0 \\ 0 & I_r \end{bmatrix}$ ,  $M = \begin{bmatrix} S'_k & \alpha \end{bmatrix}'$  and  $S'_k = \begin{bmatrix} I_k & 0 \end{bmatrix}$ .  $k$  ( $r$ ) is the number of common trends (cointegrating relations), i.e., one in our case.

<sup>23</sup>  $B(0) = I_2$ ,  $D(L) = \begin{bmatrix} I_k & 0 \\ 0 & (1-L)I_r \end{bmatrix}$  and  $\gamma^* = \begin{bmatrix} 0 & \gamma \end{bmatrix}$ , an  $2 \times 2$  matrix.



It remains to identify the transitory shocks. In order to do that, it is useful to re-write the permanent shock in (A.7) to equal:<sup>24</sup>

$$\varphi_t = (\gamma'_\perp \Sigma \gamma_\perp)^{-1/2} \gamma'_\perp \varepsilon_t. \quad (\text{A.8})$$

Apart from the cointegration restriction, we need one further restriction in order to identify the shocks. We assume that the permanent and transitory shocks are uncorrelated. Using (A.8), this assumption implies that:

$$E[\varphi_t \psi'_t] = (\gamma'_\perp \Sigma \gamma_\perp)^{-1/2} \gamma'_\perp \Sigma \Gamma'_r = 0.$$

This relation holds if  $\Gamma_r = \gamma' \Sigma^{-1}$ . With this definition of  $\Gamma_r$ , the variance of the transitory shock is:

$$E[\Gamma_r \varepsilon_t \varepsilon'_t \Gamma'_r] = \gamma' \Sigma^{-1} \gamma,$$

which is not constrained to be unity. In order to achieve that, we multiply (normalize)  $\Gamma_r$  by  $\sqrt{\gamma' \Sigma^{-1} \gamma}$  such that:

$$\psi_t = \left( \sqrt{\gamma' \Sigma^{-1} \gamma} \right) \gamma' \Sigma^{-1} \varepsilon_t. \quad (\text{A.9})$$

Hence, the permanent and transitory shocks are given by equations (A.8) and (A.9). These are then used to calculate the permanent and transitory components in (5) and (7), respectively. For the asymptotic distributions of the impulse response functions, we refer the reader to Warne (1993).

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<sup>24</sup>As shown in Johansen (1995), if  $x_t$  is integrated of order I(1) or less,  $C(1) = \alpha_\perp \xi \gamma'_\perp$  where  $\xi = (\gamma'_\perp A^*(1) \alpha_\perp)^{-1}$  and  $\alpha' \alpha_\perp = \gamma' \gamma_\perp = 0$ . Using the fact that  $\Upsilon = \alpha_\perp \pi$  (as  $\alpha' \Upsilon = 0$ ) and  $C(1) = \alpha_\perp \xi \gamma'_\perp$ ,  $\Upsilon \Upsilon' = C(1) \Sigma C(1)'$  in (A.4) implies that  $\pi = \xi \sqrt{\gamma'_\perp \Sigma \gamma_\perp}$ . Hence, algebra implies that  $\Upsilon = \alpha_\perp \xi \sqrt{\gamma'_\perp \Sigma \gamma_\perp}$  and we can therefore re-write the permanent shock in (A.7) as (A.8) which is helpful for finding an expression for the identification of the temporary shocks.