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Abstract

This paper tests Barro’s (1979) tax-smoothing hypothesis using Swedish central government data for the period 1952–1999. According to the tax-smoothing hypothesis, the government sets the budget surplus equal to expected changes in government expenditure. When expenditure is expected to increase, the government runs a budget surplus, and when expenditure is expected to fall, the government runs a budget deficit. The empirical evidence suggests that the model provides a useful benchmark and that tax-smoothing behavior can explain about 60 percent of the variability in the Swedish central government budget surplus.

Keywords: Tax smoothing; budget policy; budget deficits

JEL classification: H21; H61

I. Introduction

As noted by Jonung (2000, p. 3), “The stabilisation policy record of Sweden during the period 1970–1995 is unique. No other OECD-country experimented with as many policy switches or policy reversals as Sweden or did it so drastically.” During this period, there were no restrictions on the budget policy, and the Swedish budget balance displayed the largest volatility of all the OECD countries. There were several examples of extreme “tighten and loosen the belt” policies. For instance, the late 1970s were characterized by drastically growing budget deficits as a result of an expansionary fiscal policy aimed at “bridging over” the economic downturn that followed from the first oil price shock. By contrast, in the late 1980s, following a period of high growth and fiscal consolidation, the government ran large budget surpluses. In fact, each year during the period 1987–1989, the government had one of

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of the largest budget surpluses in the OECD. But then, once again, the situation changed drastically. In the early 1990s, a severe economic crisis and a major tax reform resulted in growing budget deficits and, in 1993, the central government displayed its largest budget deficit ever. In just four years, Sweden went from having the OECD’s strongest government finances to having the weakest. The Swedish government then adopted one of the strictest programs of fiscal consolidation in the OECD. Just a few years later, the budget was back into a surplus where it remained for the rest of the 1990s.

The purpose of this paper is to test empirically whether Barro’s (1979) tax-smoothing hypothesis (TSH) can explain the shifts in the Swedish central government’s budget balance during recent decades. According to the TSH, it can be optimal for a government to run budget surpluses as well as deficits as long as they are justified by future expectations of changes in government expenditure. In its basic form, the TSH implies that when a government expects a future increase in its expenditure, it increases the tax rate today and runs a budget surplus (smaller deficit). Conversely, when the government expects a future decrease in expenditure, it lowers the tax rate today and runs a budget deficit (smaller surplus). The rationale for this behavior is that the government wishes to smooth the tax rate over time in order to minimize the implied distortionary welfare costs from taxation. As a consequence, when the TSH is true, the expected tax rate is constant over time, or, in more formal terms, the tax rate follows a martingale.

Huang and Lin (1993) and Ghosh (1995) build on research by Campbell (1987), Campbell and Shiller (1987) and Bohn (1991) in order to explore a useful property of the TSH: by means of a vector autoregression (VAR) for government expenditure and the budget surplus, it is possible to calculate a predicted time path of the budget surplus that, given the validity of the TSH, is optimal for the government to pursue. The predicted budget surplus time series can then be compared to the actual budget surplus time series in order to visually evaluate the fit and the economic significance of the model. If the model is true, the two series should be identical. In addition, the theoretical properties of the TSH translate into cross-equation restrictions on the VAR, and standard statistical testing is therefore easily implemented to formally test the validity of the hypothesis.1


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1 The Campbell–Shiller method is widely used to evaluate rational-expectations present-value models such as the one in this paper; see Engsted (2002).
country. Using the same model, Olekalns (1997) rejects the TSH when applied to Australian data for the period 1964/1965 to 1994/1995. Huang and Lin (1993) log-linearize the model and then apply it to the United States for the period 1929–1988. For the full sample period, the TSH is rejected, but it is not rejected for the period 1947–1988. The TSH has also been applied to a couple of developing countries in Asia and here also, evidence is mixed; see Cashin, Olekalns and Sahay (1998) and Cashin, Haque and Olekalns (1999).

So far there appear to be few studies that have tested an economic hypothesis empirically in order to try to explain the shifts in the Swedish central government budget balance during the past decades. Jonung (1999) tries to explain Swedish stabilization policy during the period 1970–1995 by viewing it as the result of a learning process among politicians. He recognizes that the theory of tax smoothing may be used to explain the budget policy record during the same period, but he undertakes no formal analysis to verify it. Bohn (1998) uses the tax-smoothing framework to correct for potential omitted variables bias in a regression model that can be used to test whether the debt-to-GDP ratio is stationary. In his regression model for the debt-to-GDP ratio, tax smoothing implies that the level of temporary government spending and a business cycle indicator should be included as regressors. Hansson and Hansson (2001) apply a similar version of this model to Sweden and five other countries. For Sweden, it is only when they allow for a structural break in 1973 that the debt-to-GDP ratio is found to be stationary. Based on the sign and magnitude of the estimated regression coefficients, they argue that their results provide “modest evidence in favor of the tax-smoothing hypothesis”.

This paper is organized as follows. Some basic theoretical results of the TSH are derived in Section II, and the empirical method for evaluating the model is outlined in Section III. The TSH is then tested on Swedish central government data for the periods 1952–1999 and 1970–1996. The empirical results in Section IV indicate that for the full period 1952–1999, it is not possible to statistically reject the TSH. However, for the subperiod 1970–1996, the TSH is rejected. The visual evidence indicates that the TSH can be useful in explaining the shifts in the Swedish central government budget balance, even during the period 1970–1996. In sum, tax smoothing

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2 According to Huang and Lin, the rejection for the full sample period is due to sharp differences in the statistical properties of the data rather than the invalidity of the hypothesis itself.

3 The same goes for several studies on US data, including Barro (1981), Sahasakul (1986) and Trehan and Walsh (1988).
can explain about 60 percent of the variability in the budget surplus. Section V provides some concluding remarks.

II. The Tax-smoothing Hypothesis

Consider the TSH as derived by Ghosh (1995). The government faces the dynamic budget constraint

\[ D_{t+1} = (1 + r)D_t + G_t - \tau_t Y_t, \]  

where \( D_t \) is the stock of real government debt; \( G_t \) is real government expenditure; \( \tau_t \) is the average tax rate; \( Y_t \) is real output; and \( r \) is the fixed real interest rate. If output grows at a fixed rate equal to \( n \), the dynamic budget constraint can be expressed as

\[ (1 + n)d_{t+1} = (1 + r)d_t + g_t - \tau_t, \]  

where each lowercase letter denotes the ratio of the corresponding uppercase letter to output. In the model that follows, the ratio of government expenditure to output, \( g_t \), is assumed to be exogenously given. For simplicity, \( g_t \) and \( d_t \) are hereafter referred to as government expenditure and debt, respectively. In a stochastic setting, the intertemporal budget constraint states that if a transversality condition on debt is imposed, the sum of the present discounted value of expected government expenditure and initial debt must equal the present discounted value of expected tax rates. That is, solving (2) forward, taking expectations and imposing the transversality condition

\[ \lim_{T \to \infty} \left( \frac{1}{1 + R} \right)^T E_t (1 + n)d_{t+T+1} = 0, \]  

(3)

gives

\[ \sum_{s=t}^{\infty} \left( \frac{1}{1 + R} \right)^{s-t} E_t g_s + (1 + r)d_t = \sum_{s=t}^{\infty} \left( \frac{1}{1 + R} \right)^{s-t} E_t \tau_s, \]  

(4)

where \( s \) is the index variable for time, \( R = (r - n)/(1 + n) \) is the effective net interest rate faced by the government, and \( E_t = E(\cdot | I_t) \) is the expectations operator, conditional on the government’s information set at time \( t \), \( I_t \).

The levying of taxes is assumed to impose distortionary costs such as collection costs and deadweight losses incurred when individuals substitute away from market work. Assuming that these costs are proportional to the square of the tax rate, the government’s objective function is
where $\beta$ is the government’s subjective discount rate. The problem then is to maximize (5) subject to (2) and (3). Assuming that $\beta = 1/(1 + R)$, the Euler equation implies that for any $s > t$,

$$E_t \tau_s = \tau_t,$$

(6)

i.e., the tax rate follows a martingale or, stated less formally, a random walk. This is a first basic implication of the TSH, which has been tested in several empirical studies, including those by Barro (1981) and Sahasakul (1986).

Although (6) neatly captures the notion of tax smoothing, there are several reasons for going beyond it; see Campbell (1987). First of all, the random walk of the tax rate can be the result of a political process that is unrelated to the tax-smoothing objective. That is, it is possible that the tax rate follows a random walk yet does not satisfy the TSH. Another reason is that it is difficult to assess the economic significance of a statistical rejection of (6). A third reason is that there are useful time-series properties that are not explored when focusing solely on (6). To overcome these shortcomings, Huang and Lin (1993) and Ghosh (1995), among others, apply Campbell’s (1987) and Campbell and Shiller’s (1987) VAR approach in order to explore and test all time-series implications of the TSH. In short, the approach is to formulate the TSH as a statement about the budget surplus, as it takes into account the full structure of the model, and then use a VAR for government expenditure and the budget surplus to evaluate the implied restrictions. The same approach is used in this paper, and it allows us to assess both the statistical and economic significance of the model.

Using (6) in (4), the TSH can be written as

$$\tau_t = (r - n)d_t + \frac{R}{1 + R} \sum_{s=t}^{\infty} \left(\frac{1}{1 + R}\right)^{s-t} E_t g_s.$$

(7)

According to (7), the only martingale that satisfies the TSH is the martingale that sets the tax rate exactly equal to the annuity value of the sum of government debt and the present discounted value of expected government expenditure. Thus, the RHS of (7) is the constant flow of expenditure that is expected to be sustained for the remainder of the government’s time horizon, i.e., it is the permanent government expenditure. Optimal budget policy would then imply that the tax rate should always be set to equal permanent government expenditures.
Define the budget surplus as $\text{sur}_t = (1 + n)(d_t - d_{t+1})$. The dynamic budget constraint (2) can then be rearranged such that

$$\text{sur}_t = \tau_t - (g_t + (r - n)d_t) = \tau_t - g_t^{\text{TOT}},$$

where $g_t^{\text{TOT}}$ is total government expenditure, i.e., the sum of current expenditure, $g_t$, and the effective interest payment on government debt, $(r - n)d_t$. After substituting (7) into (8), the TSH can be stated as

$$\text{sur}_t = \tau_t - (g_t + (r - n)d_t)$$

$$= (r - n)d_t + \frac{R}{1 + R} \sum_{s=t}^{\infty} \left( \frac{1}{1 + R} \right)^{s-t} E_i g_s - (g_t + (r - n)d_t)$$

$$= \frac{R}{1 + R} \sum_{s=t}^{\infty} \left( \frac{1}{1 + R} \right)^{s-t} E_i g_s - g_t$$

$$= \sum_{s=t+1}^{\infty} \left( \frac{1}{1 + R} \right)^{s-t} E_i \Delta g_s. \quad \text{(9)}$$

Equation (9) states that when the TSH is true, optimal budget policy implies that the budget surplus is always set to equal the present discounted value of expected changes in government expenditure. Whenever expenditure is expected to increase, the government runs a budget surplus, i.e., it saves for “a rainy day”; see Campbell (1987). Conversely, when expenditure is expected to fall, the government borrows and runs a budget deficit. Thus, a temporary positive shock to expenditure implies a budget deficit. On the other hand, a permanent shock to expenditure implies no change in the budget balance as the tax rate adjusts fully to the shock. Accordingly, the behavior of a tax-smoothing government facing an exogenous stream of expenditure is analogous to the behavior of a consumer who wishes to smooth consumption over time when labor income is stochastic; see Hall (1978).

### III. Empirical Method

As pointed out by Campbell (1987), even though expectations about future expenditure are conditional on the government’s information set, $I_t$, it is still possible for an econometrician with access to only a subset of $I_t$ to calculate the predicted path of the budget surplus from (9). This is because the budget surplus itself contains all information about future changes in government expenditure that is superior to the econometrician. As a consequence, the budget surplus should Granger-cause changes in government expenditure.
expenditure. Hence, by incorporating the budget surplus and changes in expenditure into the econometrician’s information set, $H_t$, (9) can be estimated and, as shown below, the TSH can be tested taking the government’s superior information into account. The predicted path of the budget surplus is

$$\hat{\text{sur}}_t = E(\text{sur}_t|H_t) = E\left\{E\left\{\sum_{s=t+1}^{\infty} \left(\frac{1}{1 + R}\right)^{s-t} \Delta g_s | I_t\right\} | H_t\right\}$$

$$= \sum_{s=t+1}^{\infty} \left(\frac{1}{1 + R}\right)^{s-t} E(\Delta g_s|H_t),$$

(10)

since $H_t \subseteq I_t$.

The TSH formulated as a statement about the budget surplus reveals another important time-series property. If government expenditure, $g_t$, contains a unit root, its first difference will be stationary. Accordingly, the budget surplus, $\text{sur}_t$, will be stationary because it is a linear combination of expected changes in expenditure. As noted by Bohn (1991) and Ghosh (1995), although it is entirely possible that $g_t$ in reality is a stationary time series, standard econometric tests generally cannot reject the null hypothesis that it contains a unit root. This is also the case for the Swedish data used below.

Furthermore, as shown by Trehan and Walsh (1988, 1991), if $\tau_t$ and $g_t^{TOT}$ are both individually I(1) and cointegrated such that $\tau_t - g_t^{TOT} = \text{sur}_t$ is I(0), the transversality condition (3) is satisfied such that the intertemporal budget constraint (4) holds. Campbell (1987) shows that the implied error-correction model can be expressed in VAR form as

$$\begin{bmatrix} \Delta g_t \\ \text{sur}_t \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} \Delta g_{t-1} \\ \text{sur}_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{\Delta g_t} \\ \varepsilon_{\text{sur}_t} \end{bmatrix},$$

(11)

where the means of $\Delta g_t$ and $\text{sur}_t$ have been removed. After verifying that $g_t$ is I(1), and that $\tau_t$ and $g_t^{TOT}$ are both individually I(1) and cointegrated such that $\text{sur}_t$ is I(0), the VAR can be estimated in order to evaluate the TSH. The procedure is as follows. Write the VAR in matrix notation as

$$X_t = AX_{t-1} + \varepsilon_t.$$  

(12)

The forecast of a one-period change in government expenditure is

$$E(\Delta g_s|H_t) = \begin{bmatrix} 1 & 0 \end{bmatrix} A^{s-t} X_t.$$  

(13)

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4 For the annual data used in this paper, a one-lag VAR is sufficient to capture the time-series properties. If necessary, the VAR can easily be extended to incorporate several lags.
Substituting (13) into (10) gives

\[
\begin{align*}
\hat{sur}_t &= \sum_{s=t+1}^{\infty} \left( \frac{1}{1 + R} \right)^{s-t} \begin{bmatrix} 1 & 0 \end{bmatrix} A^{s-t} X_t \\
&= \begin{bmatrix} 1 & 0 \end{bmatrix} \frac{1}{1 + R} A \left( I - \frac{1}{1 + R} A \right)^{-1} X_t \\
&= \Lambda_1 \Delta g_t + \Lambda_2 sur_t.
\end{align*}
\]

(14)

If the TSH is true, the predicted budget surplus, \( \hat{sur}_t \), is equal to the actual budget surplus, \( sur_t \), i.e., \( \Lambda_1 = 0 \) and \( \Lambda_2 = 1 \). Accordingly, the following restrictions must hold for (14):

\[
\begin{bmatrix} \Lambda_1 & \Lambda_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \end{bmatrix} \frac{1}{1 + R} A \left( I - \frac{1}{1 + R} A \right)^{-1} = [0 \ 1].
\]

(15)

The nonlinear restrictions for the VAR parameters in (15) represent the formally testable implications of the overall model, and below, they are evaluated by means of Wald and likelihood ratio tests.\(^5\) As already indicated, besides formal statistical testing, the fit of the model can also be evaluated by calculating the predicted budget surplus, \( \hat{sur}_t \), according to (14) and then visually comparing it to the actual budget surplus, \( sur_t \).

**IV. Estimation and Results**

The data are taken from the *Statistical Yearbook of Sweden* (various issues), the International Monetary Fund’s *International Financial Statistics* and *Government Finance Statistics* databases, and refer to the consolidated central government, i.e., the central government units covered by the general budget, and central government units with individual budgets, including the National Debt Office, the Swedish National Social Insurance Board, and regional agencies of the Public Health Insurance Administration. Further

\(^5\) When testing the restrictions in (15), one can post-multiply (15) by

\[
\left( I - \frac{1}{1 + R} A \right)
\]

in order to obtain a simpler, linear expression to evaluate. In general, as noted by Campbell and Shiller (1987) and Gregory and Veall (1985), such a transformation can change the values and power of Wald statistics, and it may therefore be important to consider. However, for the data used in this paper, no conclusions are altered by focusing solely on testing the restrictions as expressed in (15). Test results based on the transformation yield very similar results and are available from the author on request. Note that the likelihood ratio test statistic is invariant to any transformation of the restrictions.
details regarding the data and the construction of the variables are provided in the Appendix. The sample period is 1952–1999, but separate estimation was also carried out for the sample period of 1970–1996, as it was characterized by a relatively volatile budget surplus compared to the 1950s and 1960s. The choice of studying the period 1970–1996 rather than the period 1970–1999 is also based on the fact that new budget legislation, aimed at strengthening the budget-making process, took effect at the beginning of 1997.

The first step is to verify that $g_t$ is $I(1)$, and that $\tau_t$ and $g_t^{TOT}$ are $I(1)$ and cointegrated such that $\tau_t - g_t^{TOT} = sur_t$ is $I(0)$. Table 1 displays results from Dickey–Fuller tests of the null hypothesis that the variables under consideration contain a unit root; for details, see Dickey and Fuller (1981). By means of diagnostic checking and lag-length selection tests, the augmented Dickey–Fuller regressions can in general be reduced to simple regressions without trends.\(^6\) It is well known that the regression from which the Dickey–Fuller test is derived depends critically on the assumption of serially uncorrelated residuals. In order to verify this assumption, each Dickey–Fuller test statistic in Table 1 is supplemented by a Lagrange multiplier test statistic for the null hypothesis of no residual autocorrelation. The null hypothesis of a unit root cannot be rejected for $\tau_t$, $g_t$ and $g_t^{TOT}$. By contrast, for $sur_t$, the null is rejected, which suggests that $\tau_t$ and $g_t^{TOT}$ are cointegrated.\(^7\) Dickey–Fuller tests were then performed for $\tau_t$, $g_t$ and $g_t^{TOT}$ when they are expressed in

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<th>Table 1. Dickey–Fuller tests</th>
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<td>$\tau_t$</td>
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<td>$\Delta g_t^{TOT}$</td>
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Notes: DF is the test statistic for the null hypothesis of a unit root. LM is the Lagrange multiplier test statistic for the null hypothesis of no residual autocorrelation from lags 1 to 2. ** indicates rejection at the 1 percent level of significance.

\(^6\) The only exception is $sur_t$, where the corresponding Dickey–Fuller regression for $\Delta sur_t$ for both periods has $sur_{t-1}$ and two lags of $\Delta sur_t$ as regressors.

\(^7\) Note that, since $sur_t$ by definition is equal to $\tau_t - g_t^{TOT}$, the Dickey–Fuller test for $sur_t$ is equivalent to an Engle–Granger (1987) test of the null hypothesis of no cointegration of $\tau_t$ and $g_t^{TOT}$.

their first differences. The null hypothesis of a unit root in the first difference of each series is rejected. Thus, in sum, the results of the tests suggest that $\Delta g_t$ and $\text{sur}_t$ are stationary and that the intertemporal budget constraint (4) holds.

Next, the VAR for $\Delta g_t$ and $\text{sur}_t$ was estimated, and the results are shown in Table 2. Diagnostic checking and lag-length selection tests indicated that a one-lag VAR was sufficient to capture the time-series properties. The null hypothesis that $\text{sur}_{t-1}$ non-Granger-causes $\Delta g_t$ can be rejected at the 2.6 percent level of significance for the full sample period, and at the 1.8 percent level for the period 1970–1996. Thus, for both periods, there is statistical evidence that the government has superior information.

The estimated VAR coefficients were used to calculate the estimated values of $\Lambda_1$ and $\Lambda_2$ according to (15). The results are shown in Table 3. Recall from (15) that testing the TSH translates into testing the null hypothesis that $\Lambda_1 = 0$ and $\Lambda_2 = 1$. Table 4 summarizes the results from the tests of these restrictions. The Wald and likelihood-ratio test statistics indicate that it is not possible to reject the TSH for the full sample period. However, this is not the case for the period 1970–1996. For this subperiod, the Wald statistic for the test of the TSH is equal to 16.14, which implies that the null can be rejected at any conventional level of significance. The corresponding likelihood-ratio statistic is equal to 6.39, which implies that the null can be rejected at the 4.1 percent level of significance. Hence, the results indicate that the statistical power of the tests is high; even though the sample size is reduced, it is possible to reject the TSH.

The estimated values of $\Lambda_1$ and $\Lambda_2$ were used to calculate the predicted budget surplus, $\hat{\text{sur}}_t$, as $\hat{\text{sur}}_t = \hat{\Lambda}_1 \Delta g_t + \hat{\Lambda}_2 \text{sur}_t$. Figure 1 plots the predicted and actual budget surplus time series for the full period, and Figure 2 plots the two series for the sample subperiod 1970–1996. The figures show that

\begin{table}[ht]
\centering
\caption{Estimated VAR coefficients}
\begin{tabular}{lcc}
\hline
\hline
$\hat{a}_{11}$ & 0.327 & 0.257 \\
 & (0.137) & (0.187) \\
$\hat{a}_{12}$ & 0.164 & 0.209 \\
 & (0.071) & (0.082) \\
$\hat{a}_{21}$ & -0.553 & -0.717 \\
 & (0.172) & (0.280) \\
$\hat{a}_{22}$ & 0.739 & 0.708 \\
 & (0.089) & (0.123) \\
$t_{NG}$ & 2.31 & 2.54 \\
p-Value & 0.026 & 0.018 \\
\hline
\end{tabular}
\end{table}

\textit{Notes:} Standard errors in parentheses. $t_{NG}$ is the test statistic for the null hypothesis that $\text{sur}_{t-1}$ non-Granger-causes $\Delta g_t$. 

the predicted budget surplus does a good job in tracking the actual budget surplus. From Table 3, for the full period, since \( \hat{\lambda}_1 \) is about zero and \( \hat{\lambda}_2 \) is about 0.6 such that \( \lambda_{\text{sur}} \) is approximately equal to 60 percent of \( \lambda_{\text{sur}} \), we have a rather precise result: tax smoothing can explain about 60 percent of the variability in the budget surplus. A similar result also holds for the period 1970–1996.\(^8\)

As Figures 1 and 2 show, the predicted budget surplus captures all major shifts in the actual surplus, even during the subperiod. This highlights an

| Table 3. Estimated \( \lambda_1 \) and \( \lambda_2 \) coefficients |
|--------------------------|--------------------------|
| \( \hat{\lambda}_1 \)   | -0.037                   | -0.201                   |
|                         | (0.223)                  | (0.205)                  |
| \( \hat{\lambda}_2 \)   | 0.635                    | 0.568                    |
|                         | (0.245)                  | (0.128)                  |

Notes:

\[
[\lambda_1 \ \lambda_2] = [1 \ 0] \frac{1}{1 + R} A \left( I - \frac{1}{1 + R} A \right)^{-1}.
\]

where \( A \) contains the VAR parameters. The standard errors (in parentheses) are calculated by taking the square root of the diagonal elements of the covariance matrix of \([\lambda_1 \ \lambda_2]\). This covariance matrix is calculated as \( J \Sigma J' \), where \( J \) is the Jacobian matrix, i.e., the matrix of derivatives of \([\lambda_1 \ \lambda_2]J'\) with respect to the VAR parameters, and \( \Sigma \) is the covariance matrix of the VAR parameters.

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<td>( \chi_w^2(2) )</td>
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<td>p-Value</td>
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<td>( \chi_{LR}^2(2) )</td>
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<td>p-Value</td>
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Notes: \( \chi_w^2 \) is the Wald statistic for the test of the null hypothesis that \( \lambda_1 = 0 \) and \( \lambda_2 = 1 \); \( \chi_{LR}^2 \) is the corresponding likelihood-ratio statistic.

\(^8\) These results were brought to my attention by an anonymous referee. Note that in general, when \( \lambda_1 = 0 \), the absolute value of \( \lambda_2 \) is identical to a measure of fit for this class of models called the standard deviation ratio; see e.g. Campbell and Shiller (1987) and Engsted (2002). In general, the standard-deviation ratio is defined as the ratio of the standard deviation of the predicted series \( \lambda_{\text{sur}} \) to the standard deviation of the actual series \( \lambda_{\text{sur}} \). Calculating this ratio yields an estimated value that is slightly above 0.6 for the full sample period and slightly below 0.6 for the period 1970–1996.
important insight of the Campbell–Shiller empirical method discussed above, namely the separation of economic significance from statistical significance. That is, although the TSH is statistically rejected for the period 1970–1996, the model can still capture much of the variation in the data. The sample correlations between the actual and predicted budget surplus series are above 0.98 for both estimation periods.

V. Concluding Remarks

Optimal tax-smoothing behavior implies that the government sets the budget surplus equal to expected changes in government expenditure. When
expenditure is expected to increase, the government runs a budget surplus (smaller deficit), and when expenditure is expected to fall, the government runs a budget deficit (smaller surplus).

The empirical results suggest that the TSH can be useful in explaining the sometimes dramatic shifts in the Swedish central government budget balance. The budget surplus Granger-causes changes in government expenditure and thus suggests forward-looking tax-smoothing behavior. Statistically, the TSH cannot be rejected for the period 1952–1999; however, it can be rejected for the period 1970–1996. The unique events and recurrent crises of the period 1970–1996 implied a budget surplus that is statistically too volatile to be consistent with optimal tax-smoothing behavior. Even though the TSH is statistically rejected for the period 1970–1996, the visual economic evidence still suggests tax-smoothing behavior. The results indicate that the model can explain about 60 percent of the variability in the budget surplus.

Perhaps the most useful feature of the approach in this paper is that it provides a benchmark theory for evaluating the budget balance. In the Swedish debate, it has often been argued that the Swedish budget deficit has been “dangerous” or “too large” without any reference point to what is “not dangerous” or “not too large” that is grounded in economic theory. The TSH and the approach in this paper, whereby the cointegration properties of the data are taken into account, provide such a reference point. The empirical results are consistent with intertemporal budget balance and a long-run solvency condition for the Swedish central government.

Finally, although the TSH provides a useful benchmark theory, it should be emphasized that it is based on simplifying assumptions. Since fluctuations in output may be an important source of both surpluses and deficits, the assumption of deterministic output is restrictive. Moreover, the model does not consider the variability of future government expenditure; it therefore rules out possible precautionary saving motives. Furthermore, the model does not consider utility gains associated with expenditure. Future studies of the TSH should aim at relaxing these assumptions.

Appendix

All data are annual, and the full sample period is 1950–1999. For the period 1950–1994, each year refers to the fiscal year ending in June of the same year. For instance, 1950 refers to the budget year starting on July 1, 1949, and ending on June 30, 1950. For the period 1995–1999, each year refers to the fiscal year starting on January 1 and ending on December 31.

Data for government expenditure, taxation receipts, GDP and consumer price index were taken from the International Monetary Fund’s International Financial Statistics and Government Finance Statistics (GFS) for consolidated central government databases.
Calendar year GDP was converted to fiscal year GDP by taking geometric means. Debt and interest payment on debt were taken from various issues of *Statistical Yearbook of Sweden*. Government expenditure is measured by the sum of total expenditure and lending minus repayment minus interest payment on the debt. Taxation receipts are measured by the sum of total revenue and grants. Outstanding debt, government expenditure and taxation receipts were all divided by GDP in order to obtain $d_{t+1}$, $g_t$ and $\tau_r$.

The real interest rate, $r$, was constructed in a similar manner as in Olekalns (1997). First, the nominal rate on the debt was calculated by dividing interest payment on debt by outstanding debt. Then, the corresponding time-period change in the consumer price index was subtracted from the nominal interest rate in order to obtain the budget year real interest rate. The real rate used in the calculations, $r$, was then set to equal the average of all budget year real interest rates. Following Ghosh (1995) and Olekalns (1997), the growth rate used in the calculations, $n$, was set to the average of the real GDP growth rates. Total government expenditure, $g_T^{TOT}$, was calculated as $g_t + (r - n)d_n$, and the budget surplus, $sur_t$, was calculated in accordance with (8) as $\tau_t - g_T^{TOT}$.

**References**


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