Fiscal policy and optimal taxation: Evidence from a tax smoothing exercise*

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Abstract

Testing the tax smoothing hypothesis for the EU-15, we hypothesize that the introduction of the 3%-deficit rule of the Maastricht Treaty in 1993 may have inhibited tax smoothing as EU member states are no longer capable of letting the deficit grow as much as implied by expected decreases in government expenditure. Our results show that for some countries this fiscal rule may have indeed changed the validity of the tax smoothing hypothesis thus implying that EU accession has caused welfare losses.

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1 Introduction

Following the period of subdued growth in Europe between 2002 and 2005, an academic as well as political discussion has emerged as to the role of fiscal policy in EU-member states. There is a certain degree of agreement that in many cases fiscal policy discretion (via expansionary or contractionary measures) may not have the desired effect on output (due to, e.g., implementation lags). Still, the question remains whether aggregate demand can and should be stimulated via an expansionary fiscal policy in times of subdued growth. A priori the literature as well as economists are not clear cut with regard to this subject: Some imply that expansionary fiscal policy measures are always effective in stimulating demand (the Keynesian view) whereas others claim the opposite, namely that such measures have very little or no effect (the Ricardian or Non-Keynesian view). However, even if Ricardian equivalence holds, there still is another role for fiscal policy which is to smooth taxes over time in order to render deadweight losses induced by tax rate changes as small as possible.

To be more precise, the tax smoothing hypothesis (TSH henceforward) implies that future expectations of changes in government expenditure determine whether it is optimal for a government to run either budget surpluses or deficits in the present period. That is, when an increase (decrease) in government expenditure is expected, the tax rate today is increased (cut) and the budget surplus rises (falls). The reason why governments might behave according to the TSH is simply that they want to smooth tax rates over time in order to minimize the implied distortionary welfare costs from taxation.

In the case of Europe, especially for countries that display strong fluctuations of public deficits and debt over the long run (such as, e.g., Sweden and Finland) or high public debt ratios in general (e.g. Belgium, Italy and Greece) the question is whether this evolution is the result of the desire to minimize deadweight losses from taxation (i.e. whether the data passes a statistical test of tax smoothing) or whether that, among other things, is simply the result of a political process, such as hypothesized in the literature on the political economy of budget deficits (see, e.g., Roubini and Sachs, 1989a, b).

Another related (and probably more interesting) issue relates to the start-up of the European Union and the introduction of the Maastricht Treaty (signed in 1992, commencement in 1993), which comprises two well-known fiscal criteria, namely government deficit (debt), as a percentage of GDP, must not be higher than 3% (60%).[1] Hence, every EU-member state is subject to these rules, which raises the question whether the introduction of the 3%-deficit rule inhibited tax smoothing such that countries were not able to let the deficit grow as much as implied by an expected decrease in government expenditure.[2] Statistically, this would be reflected by a structural break after the introduction of the Maastricht Treaty and a statistical rejection of the TSH after the break (if one exists).[3]

As to previous results from the literature, empirical evidence following the seminal paper by Barro (1979) is relatively mixed. Huang and Lin (1993) find that the TSH is rejected for the US for the period 1947-1988 but not for 1929-1988. Ghosh (1995) finds that the TSH cannot be rejected for Canada and the US for 1962-1988 and 1961-1988. Olekalns (1997) rejects the TSH when applied to Australian data for the period 1964/1965 to 1994/1995. Olekalns and Crosby (1998) test the TSH for Australia, the United Kingdom, and the US finding that tax smoothing cannot be rejected only for the latter. Cashin, Olekalns and Sahay (1998) and Cashin, Haque and Olekalns (1999) test the TSH for India, Pakistan and Sri Lanka, respectively; they find that the TSH is rejected only in the case of Sri Lanka. As far as the evidence for Europe is concerned, the only paper (besides Olekalns and Crosby, 1998, for the UK), to the knowledge of the authors, is the one by Adler (2006), which tests the TSH for Sweden, finding that tax smoothing is rejected for the period 1970-1996 but not for 1952-1999.

This piece of research contributes to the empirical literature in several aspects. We test for the relevance of the TSH for the EU-15 countries. Furthermore, we explicitly investigate the existence of a structural break which may have occurred due to the introduction of the Maastricht Treaty, which will help us to evaluate whether the 3%-deficit rule has indeed

[1] This rule was actually modified in the balanced-budget rule of the Stability and Growth Pact (concluded in 1996). According to the Pact, countries should reach budgetary positions close to balance or in surplus because then they could let their automatic stabilizers play fully over the cycle and thus avoid high cyclical variations. Around 2000, however, the main problem was that the majority of EU-member states never reached these close to balance positions. Hence, when GDP was growing at very moderate rates, deficits of several EU-member states came close to or even over the 3%-threshold between 2002 and 2006.

[2] For an evaluation of the impact of the Maastricht fiscal rule on the effectivity of fiscal policy see Crespo Cuaresma and Reitschuler (2007).

[3] Theoretically, the introduction of a fiscal rule should result in welfare losses which are not directly quantified in this paper. An extension of this piece of research by estimating these losses would shed more light on the direct consequences of such a rule.

prevented countries from tax smoothing. To the knowledge of the authors, the notion that the introduction of a fiscal rule could lead to a change in the relevance of tax smoothing is new when assessing this subject empirically. The paper is organized as follows: Section two introduces the theoretical model. Section three shows the econometric methodology as well as the results of the estimations. Section four concludes.

2 The theoretical model

2.1 The tax smoothing hypothesis

In testing the basic premises of the TSH we follow Ghosh (1995), Olekalns (1997) and Adler (2006). The one-period government budget constraint is represented by

$$D_{t+1} = (1+r)D_t + G_t - \tau_t Y_t \tag{1}$$

where D_t is the stock of real government debt; G_t is real government expenditure; τ_t is the average tax rate; Y_t is real output; and r is the (fixed) real interest rate. Postulating that output grows at a fixed rate equal to n[4] and dividing by output, (1) can be rewritten as

$$(1+n)d_{t+1} = (1+r)d_t + g_t - \tau_t \tag{2}$$

with the lowercase letters denoting the ratio of the respective variable to output. Since (2) holds for every period, taking expectation of (2), solving for τ_t by recursive forward substitution yields:

$$\sum_{j=t}^{\infty}\left(\frac{1}{1+R}\right)^{j-t} E_t\tau_j = \sum_{j=t}^{\infty}\left(\frac{1}{1+R}\right)^{j-t} E_t g_j + (1+r)d_t + \lim_{j\to\infty}\left(\frac{1}{1+R}\right)^{j} E_t(1+n)d_{t+j} \tag{3}$$

[4] Mind that the underlying model has a weakness because of treating the shocks to the tax base differently in the theoretical model and its empirical counterpart, namely the theoretical model assumes that output grows at a fixed constant rate (equation 2), whereas in the empirical counterpart ratios of government spending/deficits to *actual* GDP are used. However, as a matter of fact, empirically it does not make a big difference whether one uses ratios of government spending/deficits to *actual* GDP or ratios of government spending/deficits to an "artificial" GDP time series which grows at a fixed constant rate. When constructing such artificial GDP time series and running the baseline estimations again (equation 14), the results do not change dramatically. This indicates that the main conclusions drawn from the empirical results do hold even when taking into account the "mismatch" between the theoretical model and its empirical counterpart. The results are available upon request.

where j is the index variable for time, $R = (r - n)/(1 + n)$ is the effective net interest rate faced by the government, and E_t is the expectations operator, conditional on the government's information set at time t. Equation (3), the standard intertemporal government budget constraint in expected terms (i.e. in a stochastic setting), is concerned with future paths of fiscal and economic variables. It states that the net present value of expected tax rates must equal the sum of the net present value of expected government expenditure plus initial debt and the stock of debt in the limit. The intertemporal government budget requires that the limit term in (3) is equal to zero (i.e. $\lim_{j\to\infty} \left(\frac{1}{1+R}\right)^j E_t(1+n)d_{t+j} = 0$) asymptotically. Thus, the government cannot leave a debt that has a positive expected present value in the limit.

When a first-best system of lump-sum taxes does not exist, the government must seek to minimize the welfare losses which occur due to the choice of the tax rate. These losses are assumed to be an increasing, convex and time invariant function of the average tax rate. Following Barro (1979) and Ghosh (1995), the government's objective function is to maximize

$$V = -(1/2)\sum_{j=t}^{\infty} \beta^{j-t} E_t \tau_j^2, \; 0 < \beta < 1 \tag{4}$$

where β is the government's subjective discount rate and distortionary costs are presumed to be proportional to the square of the tax rate. Assuming that $\beta = 1/(1/R)$, the Euler equation implies that for any $j > t$,

$$E_t \tau_j = \tau_t \tag{5}$$

i.e. the tax rate follows a a random walk. This is the first basic implication of the TSH, which has been tested empirically by several authors, including, e.g., Barro (1981) and Sahasakul (1986), with the most common finding that tax rates do actually follow a random walk.

Using (5) in (3), the TSH can be written as

$$\tau_t = (r - n)d_t + \frac{R}{1+R}\sum_{j=t}^{\infty} \left(\frac{1}{1+R}\right)^{j-t} E_t g_j \tag{6}$$

According to (6), optimal budget policy implies that the tax rate should always be set equal to the annuity value of the sum of government debt and the net present value of expected government expenditure.

If we define the budget balance as $bal_t = (1+n)(d_t - d_{t+1})$ the dynamic government budget constraint (2) can be rewritten as

$$bal_t = \tau_t - (g_t + (r-n)d_t) = \tau_t - g_t^{tot} \tag{7}$$

where g_t^{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 (6) into (7), the TSH can be stated as

$$bal_t = \sum_{j=t+1}^{\infty} \left(\frac{1}{1+R} \right)^{j-t} E_t \Delta g_j \tag{8}$$

According to equation (8), an optimal budget policy requires that, at any point, the budget balance must be equal to the discounted sum of all future expected changes in government expenditure, i.e. the government runs a budget surplus when expenditure is expected to increase, and vice versa.

2.2 Tax smoothing versus tax tilting

When trying to understand the dynamics of budget deficits, one has to mention that there is another motivation to run budget deficits besides tax smoothing, namely tax tilting (see Ghosh, 1995, Cashin et al, 1998, 1999). The main reason for tax tilting is that the government's discount rate, β, differs from the effective interest rate, R. Given that $\beta < R$, for instance, the government would have a preference to shift taxes into the future, i.e. lower taxes today (resulting in a deficit) and then gradually raise taxes over time in order to lower the accumulated stock of debt. In other words, tax tilting creates a tendency towards either deficits or surpluses, which are, however, compatible with intertemporal solvency.[5]

As can be seen, tax tilting is based upon reasons entirely different from tax smoothing. Hence, an analysis which hypothesizes that only future changes to government expenditure motivate the government to run either budget deficits or surpluses effectively neglects the

[5] Besides the example mentioned above (i.e. a government with a high rate of time preference), two other reasons for tax tilting are high economic growth rates and low real interest rates, which will both raise R relative to β.

consideration of tax tilting. Thus, it is essential that the optimal balance derived from equation (8) refers only to the budget component that relates to tax smoothing. This can be achieved by filtering the tax tilting component from the budget balance according to

$$bal_t^{sm} = \gamma^{-1}\tau_t - (g_t + (r-n)d_t) = \gamma^{-1}\tau_t - g_t^{tot} \tag{9}$$

where $\gamma = [(1-(R/\beta)R)/(1-R)]$ is the tilting parameter. Under the assumption that bal_t^{sm} is stationary, γ^{-1} is the cointegrating parameter from the regression of $((g_t + (r-n)d_t)$ on τ_t.[6]

2.3 Empirical implementation of the tax smoothing hypothesis

In order to derive the optimal budget balance (equation (8)) a measure of anticipated future changes to government expenditure is needed. Following Campbell (1987) and Campbell and Shiller (1987), we proceed in the following way: Under the null hypothesis that tax smoothing is valid, the budget balance contains all information about future changes in government expenditure, hence the former should Granger-cause the latter. Since the smoothed budget balance bal_t^{sm} responds to expected future changes in government expenditure, it is a relevant information variable in forecasting the latter. Thus, this forecast can be obtained from a bivariate autoregressive model of $\triangle g_t^{tot}$ and bal_t^{sm}.

Hence, we estimate the following first-order unrestricted bivariate vector autoregression (VAR)

$$\begin{bmatrix} \triangle g_t^{tot} \\ bal_t^{sm} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} \triangle g_{t-1}^{tot} \\ bal_{t-1}^{sm} \end{bmatrix} + \begin{bmatrix} \varepsilon_{\triangle g_t^{tot}} \\ \varepsilon_{bal_t^{sm}} \end{bmatrix} \tag{10}$$

Rewriting (10) in matrix form gives

$$X_t = AX_{t-1} + \varepsilon_t \tag{11}$$

where A is a 2×2 matrix of coefficients and $X_t = (\triangle g_t^{tot}, bal_t^{sm})$. The forecast of a one-period change in government expenditure is

$$E_t \Delta g_j = \begin{bmatrix} 1 & 0 \end{bmatrix} A^{j-t} X_t \tag{12}$$

In order to obtain the optimal budget balance, substitute (12) into (8)

[6] For simplicity, we will henceforward refer to bal_t^{sm} as the actual budget balance.

$$\widehat{bal}_t^{ts} = \sum_{j=t+1}^{\infty} \left(\frac{1}{1+R}\right)^{j-t} \begin{bmatrix} 1 & 0 \end{bmatrix} A^{j-t} X_t$$

$$= \begin{bmatrix} 1 & 0 \end{bmatrix} \frac{1}{1+R} A \left(I - \frac{1}{1+R} A\right)^{-1} X_t$$

$$= \Lambda_1 \Delta g_t^{tot} + \Lambda_2 bal_t^{sm} = \Lambda X_t \tag{13}$$

where I is a 2×2 identity matrix and Λ is a 2×1 matrix of coefficients. If the TSH is true, the predicted budget balance, $\widehat{bal}_t^{ts}$, is equal to the actual budget balance, bal_t^{sm}, i.e. $\Lambda_1 = 0$ and $\Lambda_2 = 1$. Accordingly, the following restrictions must hold for (13):

$$\Lambda = \begin{bmatrix} 1 & 0 \end{bmatrix} \frac{1}{1+R} A \left(I - \frac{1}{1+R} A\right)^{-1} = \begin{bmatrix} 0 & 1 \end{bmatrix} \tag{14}$$

These restrictions can be tested using Wald or LR-tests. Besides these statistical tests, the TSH can also be evaluated graphically by comparing the actual with the predicted budget balance.

3 Econometric methodology and empirical results

3.1 The tax smoothing hypothesis in the EU-15: Full sample results

For the empirical analysis in testing the TSH for the EU-15,[7] we proceed in several steps:

The first goal is to obtain an estimate of the tilting parameter γ^{-1} as described before. Given that τ_t and g_t^{tot} are both I(1) variables, γ^{-1} is the cointegrating parameter from a regression of g_t^{tot} on τ_t. Since we are dealing with nonstationary time series, this should be done using the Phillips-Hansen (1990) fully modified OLS (FM-OLS) method, which yields an asymptotically correct variance-covariance estimator in the presence of serial correlation and endogeneity. The tax smoothing component of the fiscal balance, i.e. the component filtered from the tax tilting component, bal_t^{sm}, is then given by the residuals of the FM-OLS estimates of equation (9).

[7] We restricted ourselves to the EU-15 given the short time series available for the New Member States. Information on the time series used here can be found in the Appendix.

The second step is to calculate the optimal tax smoothing component of the budget balance which requires a measure of anticipated future changes in government expenditure. This is achieved by estimating a bivariate VAR given by (10) and then calculating the optimal budget balance according to (13).

Thirdly, we perform a series of hypothesis tests to verify the validity of the TSH. After testing whether bal_t^{sm} is indeed stationary, we perform Granger-causality tests on whether bal_t^{sm} Granger-causes changes in government expenditure (where a rejection of the null is a necessary, but not sufficient condition for the TSH to hold). Finally, we investigate whether the estimated VAR parameters confirm to the nonlinear restrictions given by (14). As mentioned before, besides these statistical tests, the validity of the TSH can then also be evaluated graphically by comparing the values of the optimal budget balance derived from (13) to the actual budget balance.

Finally, we test for a break in the cointegration relationship given by (9) which may have been caused by the introduction of the Maastricht Treaty and its 3%-deficit rule. If a break exists, we will then reestimate the restrictions according to (14) for the time period before and after the break, which allows us to test whether there has been a change in the validity of the TSH.

Insert Table 1 around here

The first step is to verify that τ_t and g_t^{tot} are I(1) and cointegrated such that $\tau - g_t^{tot} = bal_t^{sm}$ is I(0). Table 1 displays results from the Dickey–Fuller tests with the null hypothesis that the variables under consideration contain a unit root (see Dickey and Fuller, 1981).[8] As shown by Table 1 the null of a unit root cannot be rejected for all series of τ_t and g_t^{tot}.

Insert Table 2 around here

The second step is to estimate equation (9) using FM-OLS (as τ_t and g_t^{tot} are found to be I(1)) in order to obtain a measure of the budget balance clear of the tax-tilting component. The results from the FM-OLS estimation of (9) are presented in Table 2, bal_t^{sm} is then given by the residuals of the FM-OLS estimation (as shown by Table 1, the null of a unit root of bal_t^{sm} can be rejected for all countries). As can be seen, Hansen's (1992) L_C-test

[8] 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.

for cointegration with the null of cointegration cannot be rejected for all countries except for France. The cointegration relationship seems to be stable for almost all countries of our sample: The critical values for structural stability $MeanF$ and $SupF$ are below the critical values that would indicate instability of the cointegration relationship, again with the exception of France.

Insert Table 3 around here

We then estimate the VAR-parameters according to (10), the results are displayed in Table 3.[9] As to the Granger-causality tests (Table 3, column 6), we find that for half of the countries, namely Austria, Germany, Spain, the Netherlands, Portugal, Sweden and the UK, the null that bal_t^{sm} non-Granger causes $\triangle g_t^{tot}$ can be rejected as opposed to the other half of the countries. Among the latter are Belgium, Denmark, Greece, France, Ireland, Italy, Luxemburg and Finland. It implies that for these countries the data is not consistent with the most basic implication of tax-smoothing behaviour.

Insert Table 4 around here

Based on the results from the VAR-estimation we calculated the Λ_1- and Λ_2-parameters and the predicted budget balance according to (13), which are shown in Table 4. The last column of Table 4 presents the results of the Wald tests for the restrictions set out in (14) showing that the null of tax smoothing for Germany, Greece, the Netherlands and Portugal cannot be rejected, which suggests that these countries seem to smooth taxes over time.[10] Interestingly, all of those four countries had excessive deficits after 2002, some of them with deficits exceeding the 3% threshold by far (see Table 5).

Insert Table 5 around here

One can also compare the actual to the predicted budget balance using the estimated values for Λ_1 and Λ_2 (see Figure 1). As can be seen, in most cases the two time series correspond quite closely, especially in the case of Spain, Germany, Greece, Luxemburg, the Netherlands,

[9] Lag length selection tests have been performed to find the appropriate lag length. As Ghosh (1995) notes, lagged variables can be stacked if a higher-order VAR is required. However, in our case a one lag VAR proved to be sufficient for all countries.

[10] Note that in the case of Greece bal_t^{sm} does not Granger-cause $\triangle g_t$. Thus, even though a Wald test cannot reject that the TSH holds, the data is not consistent with the most basic implication of tax-smoothing behaviour.

Portugal, Finland, Sweden and the UK (the sample correlations are in most cases over 0.95, see Table 4, column 5).

Insert Figure 1 around here

What is also interesting to see is that for those countries, for which the TSH is not rejected, the estimated budget deficit is in several cases larger than 3% before 1993. This fact indicates that the introduction of the 3%-deficit rule may come at a cost which is that tax rates can no longer be smoothed as much as governments wanted to. It may also be one explanation why deficits of some EU-countries became excessive after 2002.

3.2 A structural break due to the introduction of the Maastricht Treaty?

As mentioned in the beginning, there might be the possibility that the introduction of the Maastricht deficit rule has prohibited countries from effectively smoothing taxes as deficits are no longer allowed to be larger than 3% of GDP. Technically speaking, the introduction of this rule may have caused a structural break, or, more precisely, the cointegration relation according to (9) may exhibit a break due to a shift in the cointegration vector. This hypothesis is tested using the methodology by Andrews and Kim (2003) for end-of-sample cointegration breakdown, which allows us to test for a structural break at the end of the observation period (contrary to usual Chow-type tests, which are only useful if the amount of observations before and after the break is large enough). Andrews and Kim (2003) propose the post-break sum of squared residuals computed with an estimator of the cointegration parameters for data up to the break as a test statistic. The critical values of this test statistic can then be approximated using parametric subsampling.[11]

We proceed in the following way: We test for a break in the period 1993-1999 (where the Maastricht fiscal rule was introduced and came into force) based on equation (9) and then reestimate the VAR and the associated $\widehat{\Lambda}_1$ and $\widehat{\Lambda}_2$ values, which allows us to test for the validity of the TSH before and after the potential break. We are particularly interested in the question whether there is a change in the relevance of the TSH.

[11] Given that the date of the break is not determined a priori, we estimate the p-values for the null of no break in the cointegration relationship for all countries and all years ranging from 1993 to 1999, where the break should have occurred. The p-values correspond to the test statistic P_b in Andrews and Kim (2003).

As to the results of the cointegration-breakdown test, we find that the null of no cointegration breakdown is rejected for Belgium, Germany, Spain, the Netherlands and the UK for at least in one year of the subsample analyzed,[12] in all cases the year 1993 proved to be the first year of this break.[13] In order to assess the effect of this structural break on the relevance of the TSH, rewrite (11) as

$$X_t = (A_1 + A_2 \mathcal{I}(t > T^*)) X_{t-1} + \varepsilon_t \tag{15}$$

where T^* will be set equal to the first year for which the P_b test rejects stability at a 5% significance level. $\mathcal{I}(\cdot)$ is a Heavyside function, taking value one if the argument is true, and zero otherwise. Based on the results from the VAR estimation, we then retest restriction (13).

Insert Table 6 around here

Table 6 presents the results of the Wald test based on the VAR pre- and post-break parameters, showing the following picture: We cannot reject the null of tax smoothing before the break for Germany and the Netherlands, as opposed to Belgium, Spain and the UK, for which the null is rejected. After the break, the null of tax smoothing is strongly rejected for all countries, confirming our initial hypothesis that the introduction of the Maastricht Treaty has indeed inhibited some countries from tax smoothing. One reason why Germany and the Netherlands have been able to smooth taxes before 1993 could be that they have tended to display rather prudent budgetary behaviour already prior to the introduction of the Maastricht Treaty thus not letting debt levels getting to high.[14] Therefore they might have had more room for budgetary manoeuvre, contrary to, for instance, Belgium, which has had a history of relatively high debt levels and thus not been able to let deficits grow as much as suggested by the TSH. Interestingly, the two countries, which exhibit a change in the validity of tax smoothing, namely Germany and the Netherlands, are the ones which have had excessive deficits (i.e. a deficit of more than 3%) after 2002. This may be an

[12] Mind that compared to the baseline estimations (where we cannot reject that the TSH holds for Germany, Greece, the Netherlands and Portugal) no structural break is found for Greece and Portugal. Theoretically, however, the fact that no structural break is found for Greece and Portugal does not necessarily imply that these countries do not smooth taxes. It only suggests that the Maastricht Treaty did not induce a change in fiscal behaviour.

[13] Detailed results are available upon request.

[14] The average and maximum budget deficits for Germany and the Netherlands before 1993 were -2.0%/-5.8% and -3.2%/-6.0%.

indication that for these countries, given they have had superior information on the budget deficit, minimizing implied distortionary welfare costs from taxation was more important than being subject to the Excessive Deficit Procedure by the European Commission.

4 Conclusions

This piece of research presents evidence concerning the tax smoothing hypothesis (TSH) for a set of European countries (the EU-15). We hypothesized that the introduction of the 3%-deficit rule of the Maastricht Treaty may have resulted in deadweight losses since countries are no longer capable of smoothing taxes as much as they want. Our basic estimations show that the TSH cannot be rejected for 4 out of 15 EU-member states, namely Germany, Greece, the Netherlands and Portugal.

When we test for a structural break which may have occurred due to the introduction of the Maastricht-deficit rule, we find that five countries exhibit a break (which for all countries occurs in 1993), namely Belgium, Germany, Spain, the Netherlands and the UK. Retesting the validity of the TSH for these countries before and after the break shows that the TSH cannot be rejected for two countries before the break, namely Germany and the Netherlands, whereas it is rejected for all countries after the break. It implies that for Germany and the Netherlands, the introduction of the Maastricht fiscal rule may have indeed inhibited tax smoothing.

Certainly the introduction of the Maastricht Treaty and the Stability and Growth Pact has had positive effects in terms of credibility and fiscal policy conduct. However, it might have also come at a certain cost, one being that governments are no longer able to smooth tax rates, which would thus create welfare losses. This is the direct consequence of a fiscal rule which is too strict, neither respects history nor other economic principles and is based on a "one-size-fits-all" principle. The hypothesis that the introduction of the Maastricht fiscal rule may have caused such losses is actually confirmed by the data for two countries (even though for the majority of the EU-15 the TSH does not hold). The revision of the Stability and Growth Pact implemented in 2005[15] which tries to take country-specific characteristics

[15] The revision of the Stability and Growth Pact was based on the conclusion that a "one-size-fits-all-rule" may not be appropriate for EU-member states. The revision follows a case by case evaluation (i.e. country-specific economic and budgetary circumstances are taken into account) contrary to the "one-size-fits-all" approach taken in the original Pact. For an overview of the revisions see European Commission, 2006.

into account are thus more than welcome.

A Appendix

The data source for all time series used in the estimation is the AMECO database of the European Commission. For the countries in our sample, the data availability is heterogeneous. The following time series are available: Belgium, Denmark, Germany, Spain, the Netherlands, Sweden and the UK: 1970-2006; Finland: 1974-2006; Austria: 1976-2006; Portugal: 1977-2006; France: 1978-2006; Italy: 1980-2006, Ireland: 1985-2006; Greece: 1988-2006, Luxemburg: 1990-2006.

References

[1] Andrews, D. W. K. and J. Y. Kim (2006), End-of-sample cointegration breakdown tests, *Journal of Business and Economic Statistics* 24, 379-394.

[2] Adler, J. (2006), The tax-smoothing hypothesis: Evidence from Sweden, 1952-1999, *Scandinavian Journal of Economics* 108, 81-95.

[3] Barro, R. J. (1979), On the determination of the public debt, *Journal of Political Economy* 87, 940–971.

[4] Barro, R. J. (1981), On the predictability of tax-rate changes, NBER Working Paper 636; reprinted in Barro, R. (1990), Macroeconomic policy, Harvard University Press, Cambridge, MA.

[5] Campbell, J. Y. (1987), Does saving anticipate declining labor income? An alternative test of the permanent income hypothesis, *Econometrica* 55, 1249–1273.

[6] Campbell, J. Y. and R. Shiller (1987), Cointegration and tests of present value models, *Journal of Political Economy* 95, 1062–1088.

[7] Cashin, P., Haque, N. and O. Olekalns (1999), Spend now, pay later? Tax smoothing and fiscal sustainability in South Asia, IMF Working Paper 99/63, International Monetary Fund, Washington, DC.

[8] Cashin, P., Olekalns, O. and R. Sahay (1998), Tax smoothing in a financially repressed economy: Evidence from India, IMF Working Paper 98/122, International Monetary Fund, Washington, DC.

[9] Crespo Cuaresma, J. and G. Reitschuler (2007), Is the Ricardian equivalence proposition an "aerie fairy" theory for Europe? *Economica* 74, 682-694.

[10] Dickey, D. A. and W. A. Fuller (1981), Likelihood ratio statistics for autoregressive time series with a unit root, *Econometrica* 49, 1057–1072.

[11] European Commission (2006), Public finances in EMU 2006, *European Economy* 3/2006.

[12] European Commission (2007), Public finances in EMU 2007, *European Economy* 3/2007.

[13] Ghosh, A. R. (1995), Intertemporal tax-smoothing and the government budget surplus: Canada and the United States, *Journal of Money, Credit, and Banking* 27, 1033–1045.

[14] Hansen, B. E. (1992), Tests for parameter instability in regressions with 1(1) processes, *Journal of Business and Economic Statistics* 10, 321-35.

[15] Huang, C.-H. and K. S. Lin (1993), Deficits, government expenditure, and tax smoothing in the United States: 1929–1998, *Journal of Monetary Economics* 31, 317–339.

[16] Olekalns, N. (1997), Australian evidence on tax smoothing and the optimal budget surplus, *Economic Record* 73, 248–257.

[17] Olekalns, N. and M. Crosby (1998), Some long run evidence on tax smoothing, Department of Economics Research Paper 609, University of Melbourne.

[18] Phillips, P. C. B. and B. E. Hansen (1990), Statistical inference in instrumental variables regression with 1(1) processes, *Review of Economic Studies* 57, 99-125.

[19] Roubini, D. and J. Sachs (1989a), Government spending and budget deficits in the industrialized countries, *Economic Policy* 8, 99-132.

[20] Roubini, D. and J. Sachs (1989b), Political and economic determinants of budget deficits in the industrial countries, *European Economic Review* 33, 903-938.

[21] Sahasakul, C. (1986), The U.S. evidence on optimal taxation over time, *Journal of Monetary Economics* 18, 251-75.

Table 1: Dickey Fuller Tests

Country	$\mathbf{g_t^{tot}}$	$\boldsymbol{\tau_t}$	$\mathbf{bal_t^{sm}}$	$\Delta\mathbf{g_t^{tot}}$	$\Delta\boldsymbol{\tau_t}$
Austria	-0.11	0.35	-3.78 ***	-4.76 ***	-5.41 ***
Belgium	-0.32	1.44	-3.05 ***	-2.43 ***	-4.57 ***
Denmark	0.32	1.05	-2.99 ***	-3.96 ***	-6.70 ***
Germany	0.36	0.79	-5.11 ***	-6.26 ***	-5.63 ***
Greece	-0.29	0.80	-3.37 ***	-4.29 ***	-1.93 **
Spain	1.33	3.50	-2.01 **	-3.89 ***	-1.83 **
France	1.32	1.70	-2.48 ***	-2.48 ***	-4.62 ***
Ireland	-1.23	-0.89	-2.34 ***	-2.62 ***	-4.48 ***
Italy	0.74	1.89	-2.04 **	-4.20 ***	-4.47 ***
Luxemburg	-0.62	-1.20	-2.58 ***	-3.16 ***	-4.56 ***
Netherlands	0.00	0.44	-4.60 ***	-3.74 ***	-4.47 ***
Portugal	1.73	2.73	-4.15 ***	-4.18 ***	-4.77 ***
Finland	0.00	0.40	-2.70 ***	-3.42 ***	-6.08 ***
Sweden	0.22	0.97	-3.01 ***	-3.41 ***	-4.75 ***
UK	0.01	-0.25	-4.00 ***	-3.73 ***	-7.44 ***

***(**)[*] indicates rejection at the 1% (5%) [10%] level of significance; bal_t^{sm} is calculated as the residuals of the cointegration equation (9).

Table 2: Results from the FM-OLS estimation

Country	γ^{-1}	L_C	MeanF	SupF
Austria	1.59 (0.37)	0.09	0.65	1.61
Belgium	2.11 (1.13)	0.10	1.17	1.79
Denmark	1.09 (0.23)	0.19	3.73 *	8.97
Germany	1.70 (0.22)	0.34	2.82	6.97
Greece	0.22 (0.22)	0.35	0.22	10.04
Spain	1.03 (0.15)	0.05	0.83	1.53
France	1.90 (0.29)	0.81 ***	5.60 ***	12.01 **
Ireland	2.07 (0.20)	0.31	4.27 *	8.03
Italy	1.35 (0.49)	0.11	1.55	4.14
Luxemburg	0.83 (0.54)	0.18	1.26	1.83
Netherlands	1.49 (0.08)	0.19	0.99	2.16
Portugal	0.80 (0.08)	0.12	1.19	3.97
Finland	1.86 (0.45)	0.14	3.61	17.86 ***
Sweden	1.13 (0.65)	0.21	1.78	4.55
UK	1.58 (0.58)	0.16	1.26	4.39

***(**)[*] stands for 1% (5%) [10%] significant, γ^{-1} is the Phillips-Hansen (1990) fully modified OLS estimate of the tax tilting parameter (associated standard errors in parenthesis). LC is the test for cointegration with the null of cointegration, MeanF and SupF are the tests for structural stability.

Table 3: Estimated VAR-coefficients

Country	$\mathbf{a_{11}}$	$\mathbf{a_{12}}$	$\mathbf{a_{21}}$	$\mathbf{a_{22}}$	t_{ng}
Austria	0.04 (0.19)	0.32 (0.19)	-0.21 (0.17)	0.40 (0.18)	2.80 **
Belgium	0.06 (0.17)	0.18 (0.14)	0.17 (0.18)	0.57 (0.15)	0.80
Denmark	0.42 (0.18)	0.09 (0.10)	-0.69 (0.16)	0.68 (0.09)	1.33
Germany	0.22 (0.20)	0.61 (0.21)	-0.03 (0.21)	0.12 (0.22)	4.85 ***
Greece	0.25 (0.22)	0.92 (0.27)	-0.19 (0.20)	0.18 (0.26)	1.78
Spain	0.45 (0.16)	0.27 (0.12)	-0.43 (0.18)	0.65 (0.13)	4.28 ***
France	0.28 (0.21)	-0.11 (0.13)	-0.33 (0.27)	0.61 (0.16)	0.25
Ireland	0.37 (0.25)	0.15 (0.22)	-0.24 (0.19)	0.50 (0.17)	1.12
Italy	0.36 (0.19)	0.06 (0.10)	-0.22 (0.15)	0.90 (0.08)	0.43
Luxemburg	0.21 (0.30)	0.34 (0.27)	-0.17 (0.24)	0.61 (0.22)	1.96
Netherlands	0.24 (0.15)	0.62 (0.15)	0.18 (0.17)	0.28 (0.18)	9.57 ***
Portugal	0.32 (0.17)	0.56 (0.17)	-0.27 (0.19)	0.36 (0.18)	6.66 ***
Finland	0.69 (0.13)	0.26 (0.10)	-0.47 (0.18)	0.62 (0.13)	1.61
Sweden	0.41 (0.17)	0.17 (0.07)	-0.56 (0.17)	0.85 (0.07)	5.35 ***
UK	0.60 (0.13)	0.25 (0.09)	-0.43 (0.12)	0.67 (0.08)	3.00 ***

***(**)[*] indicates rejection at the 1% (5%) [10%] level of significance. t_{ng} is the test statistic for the null that bal_{t-1} non Granger-causes Δg_t.

Table 4: Estimated Λ_1 and Λ_2 coefficients

Country	$\widehat{\boldsymbol{\Lambda}}_1$	$\widehat{\boldsymbol{\Lambda}}_2$	Wald test	Sample corr
Austria	-0.05 (0.19)	0.45 (0.29)	15.60 ***	0.994
Belgium	0.12 (0.23)	0.41 (0.38)	26.83 ***	0.970
Denmark	0.33 (0.33)	0.29 (0.31)	43.93 ***	0.803
Germany	0.22 (0.35)	0.81 (0.51)	0.07	0.968
Greece	0.06 (0.30)	1.10 (0.60)	0.16	0.998
Spain	0.14 (0.30)	0.85 (0.42)	26.84 ***	0.994
France	0.54 (0.46)	-0.25 (0.51)	30.26 ***	-0.846
Ireland	0.41 (0.48)	0.44 (0.68)	7.08 ***	0.670
Italy	0.37 (0.36)	0.42 (0.81)	51.86 ***	0.893
Luxemburg	0.07 (0.39)	0.87 (0.82)	6.37 **	0.997
Netherlands	0.54 (0.50)	1.25 (0.70)	5.51 *	0.947
Portugal	0.08 (0.26)	0.99 (0.40)	5.53 *	0.997
Finland	0.65 (0.54)	1.01 (0.41)	17.11 ***	0.894
Sweden	-0.17 (0.31)	0.91 (0.35)	17.04 ***	0.996
UK	0.42 (0.35)	0.96 (0.34)	34.09 ***	0.955

The coefficients $\widehat{\Lambda}_1$ and $\widehat{\Lambda}_2$ are the estimated parameters from equation (13) and the numbers in parenthesis are the associated standard errors, which are calculated by taking the square root of the diagonal elements of the covariance matrix of $[\ \Lambda_1 \quad \Lambda_2\ ]$. The latter is calculated as $J \sum_A J'$, J being the Jacobian matrix, i.e., the matrix of derivatives of $[\ \Lambda_1 \quad \Lambda_2\ ]'$ with respect to the VAR parameters, $\sum_A$ being the covariance matrix of the VAR parameters. The Wald test statistic (distributed as χ^2_2) tests whether the estimated VAR-coefficients satisfy the restrictions given by (14). Sample corr is the sample correlation between the estimated and the actual budget balance.

Table 5: **Deficits for selected countries**

	2003	2004	2005	2006
Germany	-3.8	-3.7	-3.3	-1.7
Greece	-5.2	-6.9	-5.5	-2.6
Netherlands	-3.2	-1.9	-0.3	0.6
Portugal	-2.9	-3.2	-6.1	-3.9

The countries displayed in this Table are the ones for which the TSH cannot be rejected (see Table 4). Data Source: Public Finance Report, Euopean Commission (2007).

Table 6: Results for the Wald tests for countries with break

Country		Wald test	
	break	before break	after break
Belgium	1993	7.83 ***	30.04 ***
Germany	1993	0.34	1722.35 ***
Spain	1993	6.25 **	71.87 ***
Netherlands	1993	1.68	25.96 ***
UK	1993	14.73 ***	26.52 ***

The numbers are the results from the Wald test statistic (distributed as χ^2_2), which should show whether the estimated VAR coefficients satisfy the restrictions given by (14). The break year is the first year with a p-value of ≤ 0.05 in the Andrews and Kim (2003) test for end-of-sample cointegration breakdown.

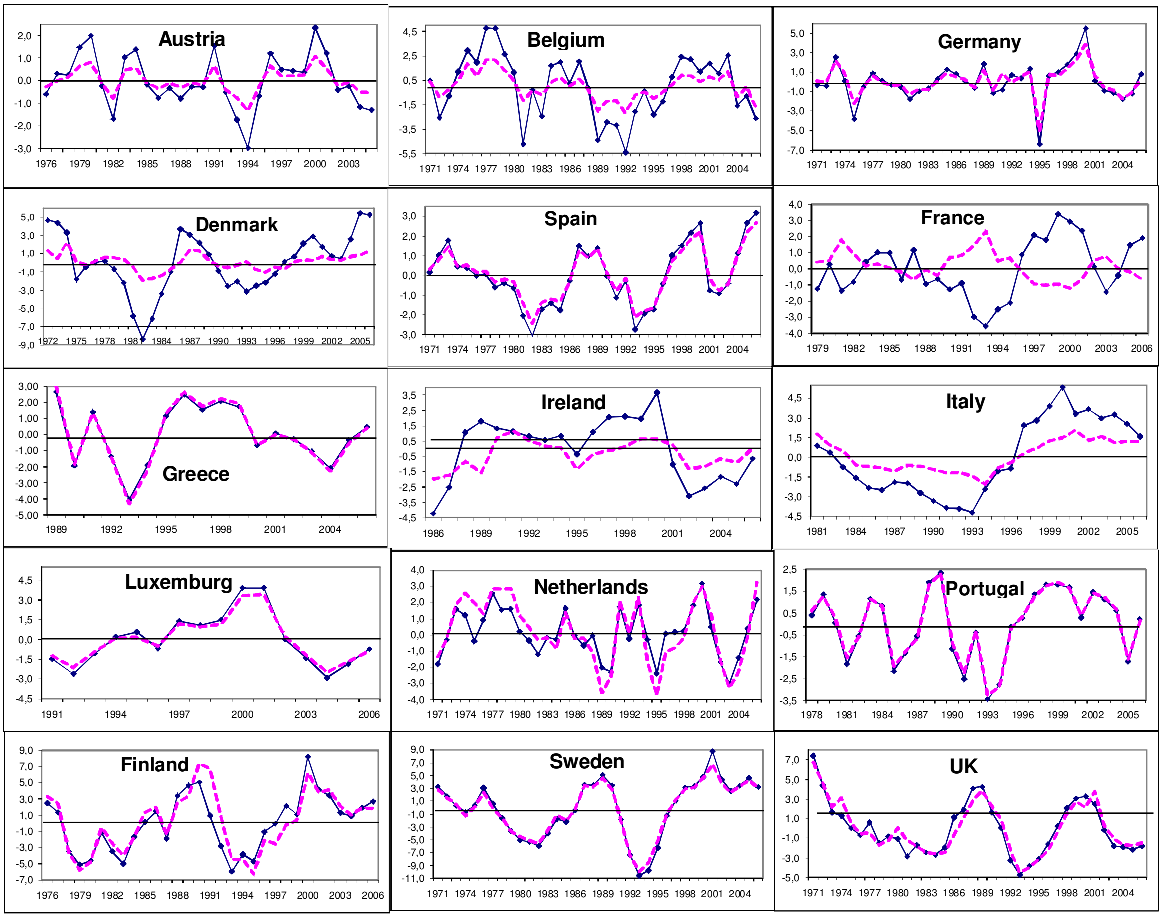

Figure 1: Actual and estimated budget balances. The solid line corresponds to bal_t^{sm} and the dotted line is the predicted budget balance given by (13).