The Long Shadow of "Austrokeynesianism"?

Public Debt Sustainability in Austria*

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Abstract

This paper analyzes whether Austrian fiscal policies have been sustainable during the last four decades. We give an introduction to Austrian fiscal policy, emphasizing its macroeconomic orientation, especially during the period called "Austrokeynesianism". Next, several econometric approaches to test for the sustainability of fiscal policies are applied to Austrian data. Most of these tests indicate that Austrian fiscal policies were sustainable in the period 1960–1974, while from 1975–2003, public debt grew much more rapidly, although (at least weak) sustainability of its development cannot be ruled out.

Keywords: fiscal policy, sustainability, public debt, time series, econometric tests, stationarity.

JEL Classification: H6, E6

1. Introduction

After a few years during which the objective of a balanced budget was emphasized in Austria, in October 2004, the Austrian federal minister of finance announced a planned federal budget deficit of about 2 percent of GDP for the fiscal year 2005. He and other officials repeatedly argued that the soon-to-come tax reform with lower income tax rates would be necessary to promote employment, investment and private consumption. This may be interpreted as a return to one of the basic ideas of “Austrokeynesianism”, a policy-mix including activist (mostly expansionary) fiscal policy design to combat unemployment and enhance growth. It should be noted, however, that the idea of a budget balanced in the long run was not alien to Keynes himself; within the concepts of countercyclical budgetary policies, the idea of paying back incurred debt by generating a surplus in economic boom periods plays a central role.

During the 1990s and at the beginning of this century, the issue of public debt has become more and more a public concern of both economists and politicians. Increasing public debt in Austria as well as in most of the OECD countries is on the daily political agenda. The Stability and Growth Pact (SGP) and the Maastricht criteria for prospective member countries of the European Economic and Monetary Union (EMU) directed fiscal policies towards sustainability, but due to the difficulties in meeting these criteria, their interpretation has become “loose” over time, allowing for larger deviations from a balanced budget than previously agreed upon. One of the key ideas of the SGP is the prevention of spillover of unsustainable fiscal policies from individual member states, e.g. via rising interest rates within the EMU, causing crowding out and higher interest rate levels in the whole euro area or undesirable effects on the exchange rate of the euro towards other currencies (cf. e.g. Gros and Thygesen, 1998; De Grauwe, 2003).

There is much debate on the question of what kind of fiscal policy is sustainable in the long run. Even if the economic position of the government is regarded as different from that of a private household, there is general agreement among economists that the government has to decide on fiscal policies in line with some long-term budget constraint. The most general guidelines for sustainability regard the relation between accumulated discounted future government budgetary surpluses and discounted future government debt, including the initial stock of debt. No rational private agent would lend money to a government if they expected that the debt could not be paid back (unless compensated by very high interest payments before default).

However, such an approach requires a lot of information regarding past, present and future government budgetary policies. There are several methodologies to test for the sustainability of fiscal policy. Two broad approaches will be applied in the current paper. First, several econometric approaches are applied to test for the stationarity of the series of discounted public debt. If the series is stationary, i.e. if public debt does not increase in the long run and exceed discounted future surpluses, fiscal policy is ("strongly") sustainable. Second, a model is tested that takes the reactions of fiscal policy-makers to rising public debt into account. If policy-makers increase the primary surplus as a reaction to increased public debt in the previous period, and if this reaction is strong enough, fiscal policy is ("weakly") sustainable.

This paper is structured as follows: Section 2 describes the present situation of the federal budget in Austria and the historical development of federal debt and deficit. Section 3 briefly reviews the theoretical framework of the government budget constraint. Section 4 presents the results of some econometric tests regarding the stationarity of the discounted public debt. Next, we apply Bohn's test for sustainability (Bohn, 1998) for Austria in Section 5. Finally, Section 6 summarizes the results of the paper.

2. Public Debt and Deficit in Austria

As in most EMU member states, the current debt-to-GDP ratio in Austria is clearly above the EMU target of 60% for general government debt. This is mainly due to increases in central (federal) government debt; federal provinces ("states", "Bundesländer") and communities and municipalities account for only a relatively small part of the public sector and have even obtained budgetary surpluses in some years in the recent past. The consolidation of the federal budget, however, cannot yet be labeled successful even if the entry conditions for Austria's membership in the EMU were fulfilled (cf. Breuss, 1999). As consistent time series data on public debt over a longer period are only available for the central (federal) government ("Bund"), in the present paper the analysis is confined to this level of the Austrian public sector. As Austria is a federally organized country with nine federal provinces, over 2,500 communities and numerous "parafisci" and state-owned companies, a consistent fiscal policy can only be expected at the level of central government. Of course, all public debt has to be taken into account when fulfillment of the SGP criteria is evaluated.

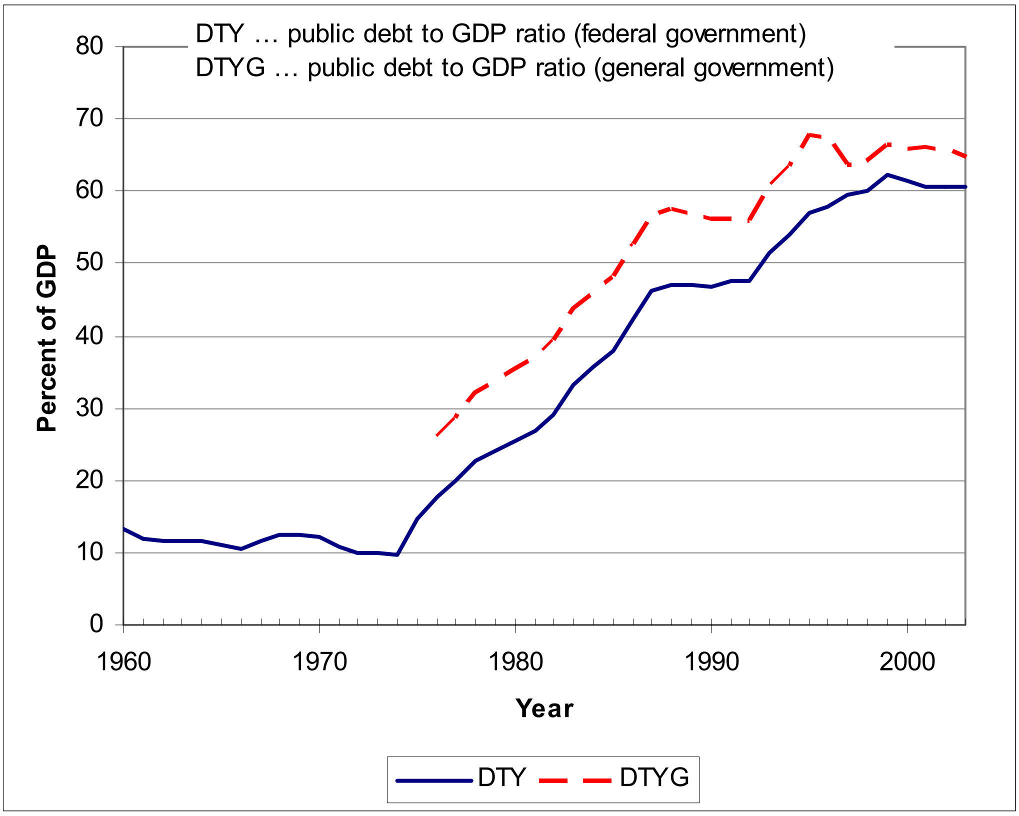
The descriptive literature on public finances in Austria (e.g. Seidel, 1985; Smekal and Gantner, 1983; Neck, 2005) identifies three or possibly four different periods of fiscal policies in the past:

1. From World War II until the mid-1950s, fiscal policy was mostly characterized by balanced federal budgets.
2. From 1958 to 1974, ideas of Keynesian stabilization policies influenced fiscal policy decisions in Austria. As a result, fiscal policies were designed to smooth the business cycle, aiming at a balanced budget in the medium or long run (over the cycle). This was mostly achieved; hence the federal debt-to-output-ratio remained constant on average during these years. One reason for this was the high average growth of real GDP during this period (and period 1), which enabled policy-makers to enjoy a considerable “growth dividend”.
3. Starting with the first oil price shock, which hit Austria in 1975, Austria’s growth rates were reduced and significantly higher fiscal deficits were built up. Although, Keynesian policy prescriptions were losing their appeal during these years on an international level, most Austrian policy-makers (especially the then dominating party SPÖ – Social Democrats) still insisted on some kind of “Austrokeynesianism” as their economic policy ideology, aiming at full employment by applying instruments of fiscal policy in an expansionary way. There were several attempts at consolidating the federal budget, but these efforts were only temporarily successful because they did not result in a fall in federal government debt (relative to GDP) but merely delayed further increases by a few years.
4. Possibly, there is a fourth fiscal policy regime starting with Austria’s entry into the EU (and the aim of fulfilling the Maastricht criteria to become a member of the Euro Area) or (more likely) starting with the “center-right” government of the Austrian Peoples’ Party (ÖVP; Christian Democrats) and the Freedom Party (FPÖ; right-wing) in 2000. One of the declared

objectives of this government was the achievement of a balanced budget ("zero budget deficit"). Whether this really represents a regime change, is still an open question at the moment.

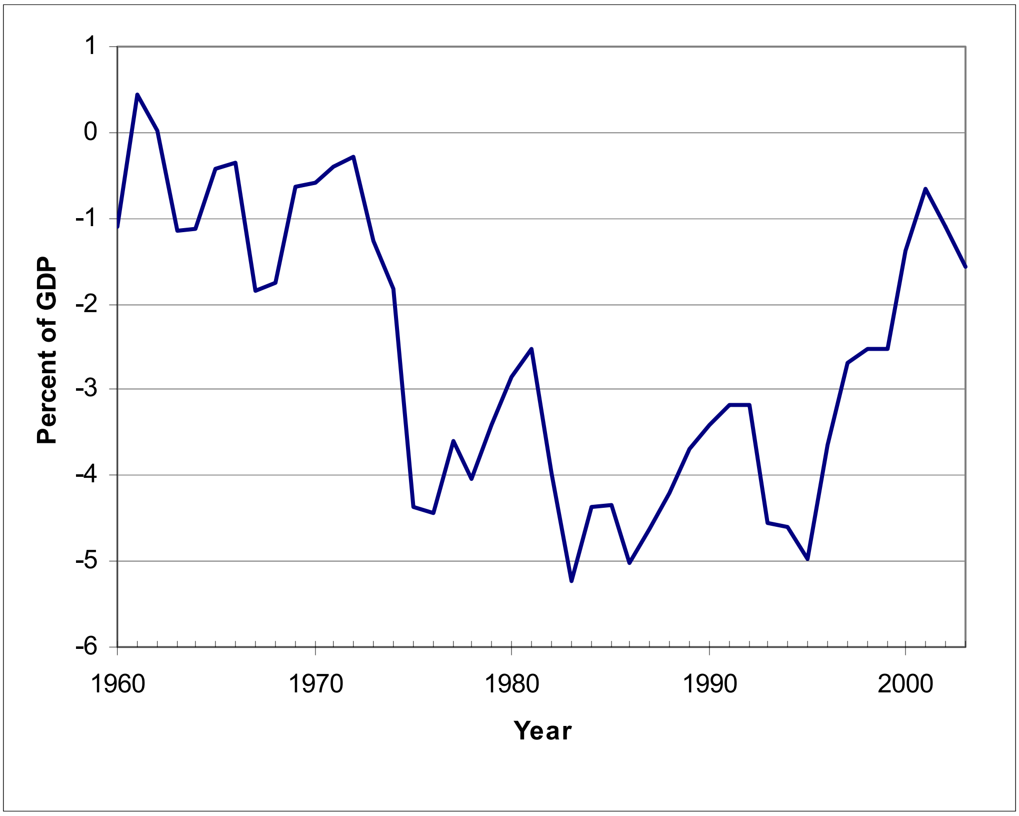
Figure 1 shows the development of the federal and the central government debt in Austria relative to Austrian GDP (debt-to-GDP ratio) since 1960 and since 1976, respectively (source: WIFO database; earlier SNA-GDP data linked to ESA95 data; our own calculations).

Figure 1: Federal and General Government Debt-to-GDP Ratio for Austria



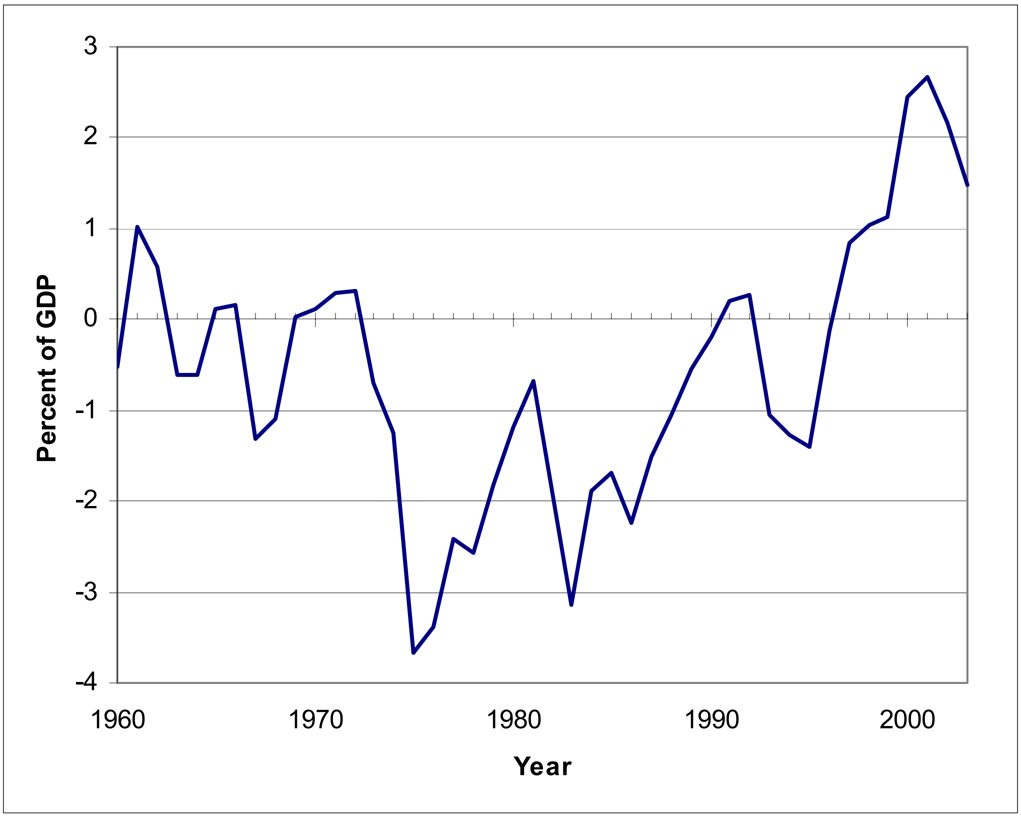
Although the current (net) federal government deficit-to-GDP ratio in Austria is below the critical (SGP) value of 3%, this is neither sufficient for stabilizing federal government debt nor fully in line with the recent budget consolidation program submitted to the EU Commission. In contrast to the "gross budget surplus", the "net budget surplus" does not include payments to settle outstanding debt. Therefore, the (economically more relevant) net budget deficit is closely related to the increase in public debt and is also the politically more important variable. Figure 2 shows that the net surplus of the federal government in Austria was (with only a few exceptions) negative, i.e. net federal budget deficits occurred during the last decades.

Figure 2: (Net) Budget Surplus (Ratio to GDP) for Austria



Some information about the composition of these deficits can be inferred from Figure 3, where the primary surplus (its ratio to GDP) for the same period is presented. In spite of some sub-periods with (sometimes even high) primary surpluses, interest payments on outstanding public debt have been so high (and grown so much) as to turn primary surpluses into net deficits. This may also be seen as one crucial factor associated with unsustainable fiscal policies: if, in the long-run, public debt rises beyond a critical level, primary surpluses might not be sufficient even to finance interest payments. This can lead to a vicious circle of incurring additional debt in order to be able to service present debt.

Figure 3: Primary Budget Surplus (Ratio to GDP) for Austria



3. Some Theoretical Considerations

The development of public debt in discrete time can be described by the accounting identity (all variables in nominal terms)

$$B_t = B_{t-1}(1 + r_{t-1}) - S_t \,, \tag{1}$$

where B_t denotes real public debt, r_t is the real rate of interest, and S_t denotes the real primary surplus (budgetary surplus excluding interest payments). Given interest payments, the stock of public debt increases even if government revenues are equal to government expenditures excluding interest payments (i.e. if S_t = 0) as the government has to finance interest payments by an increase in public debt.

Defining a discount factor d_t by

$$d_t = \prod_{j=0}^{t-1} (1+r_j)^{-1}\ ,\ \ d_0=1, \tag{2}$$

the present value of both sides of equation (1) can be rewritten as:

$$B_t d_t = B_{t-1} d_{t-1} - S_t d_t\ . \tag{3}$$

Defining $B_t d_t \equiv b_t$ and $S_t d_t \equiv s_t$, we get

$$b_t = b_{t-1} - s_t\ . \tag{4}$$

Reformulating equation (4) by recursive substitution leads to

$$b_{t+N} = b_t - \sum_{j=1}^{N} s_{t+j}\ . \tag{5}$$

If we require future discounted real public debt to go to zero in the limit, the present value of public debt has to be equal to the sum of discounted expected future primary surpluses:

$$b_t = E_t \sum_{j=1}^{N} s_{t+j}\ , \tag{6}$$

with E_t denoting the expectations operator. Equation (6) is a “strong” form of the intertemporal (present value) borrowing constraint of the government. The following condition is equivalent to the requirement for this budget constraint (6) to be fulfilled:

$$\lim_{N\to\infty} E_t b_{t+N} = 0\,, \tag{7}$$

which is commonly known as the no-Ponzi-game condition. This condition states that (private or public) agents cannot indefinitely accumulate debt by borrowing new money to pay back their old liabilities including interest payments. An alternative, weaker, condition demands stationarity of the debt-to-GDP ratio, which is sufficient for sustainability if Ponzi-games are considered admissible in the long run.

In the following sections, we apply several statistical tests to shed light on the question as to whether Austrian fiscal policy is sustainable in the sense that condition (6), i.e. the strong intertemporal government budget constraint, is fulfilled. We follow and extend the studies by Greiner and Semmler (1999) for Germany and Getzner et al. (2001) for Austria.

4. Tests for Stationarity of Austrian Budgetary Policies

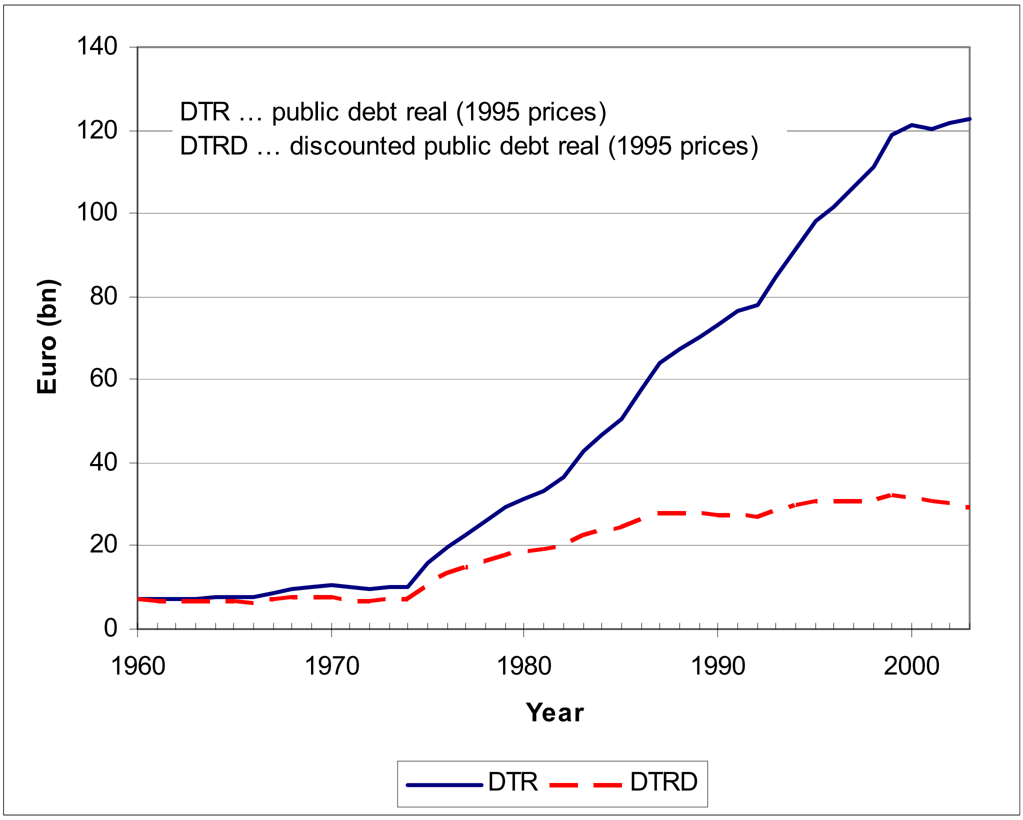
The General Approach

Fulfilling the budget constraint according to equation (6) means that public debt b_t at time t can be paid back by surpluses in future periods. In the following, the fulfillment of this constraint is taken as the null hypothesis. We start from the equation

$$b_t = A_0 \prod_{j=1}^{t} (1 + r_j) + E_t \sum_{j=1}^{\infty} s_{t+j}\ . \tag{8}$$

The intertemporal budget constraint is fulfilled if A_0=0 which means that b_t will be stationary for any stationary series of s_t. If A_0>0, b_t will not be stationary, i.e. public debt at time t cannot be paid back by expected future surpluses. As a first empirical indication of the sustainability of Austrian budgetary policy, Figure 4 shows real public debt and discounted real public debt for the period 1960–2003 (annual data). “Real public debt” is the time series of the central (federal) government’s financial debt at 1995 prices; the series of nominal federal government’s financial debt was taken from the database of the Austrian Institute of Economic Research (WIFO) and deflated with the GDP deflator. The discounted real public debt figures were calculated by using a discount factor according to equation (2). The annual net return of newly emitted bonds (without government bonds) was used as the (variable) discount rate. This procedure may be criticized as testing for “ad hoc sustainability” (Bohn, 2006), but the interest rate used is the only one that is available in a consistent way for the whole period of 1960 to 2003 and hence may be interpreted as a proxy for the theoretically adequate use of prices for contingent claims in the no-Ponzi-game condition and the “true” intertemporal budget constraint.

Figure 4: Real Federal Public Debt and Discounted Real Public Debt in Austria, 1960–2003 (1995 prices)



Clearly, discounted real federal government debt and particularly undiscounted real federal government debt show a sharp increase in the mid-1970s, which is consistent with the data of the debt-to-GDP ratio shown in Figure 1. Between 1960 and 1974, the series follow a stable path without much variation. The year 1975 seems to mark a structural break in Austrian budgetary policies. From 1975 to 2003, real federal government debt increased from around EUR 16 bn to around EUR 123 bn (at 1995 prices), corresponding to an increase in the debt-to-GDP ratio from about 10% in 1974 to about 61% in 2003. A visual inspection of the data gives the impression of another structural break between 1999 and 2000, which might be related to the efforts of Austrian governments to fulfill the Maastricht Criteria for entering the EMU and sticking to the SGP or the policy goal of a balanced budget proclaimed by the “center-right” government in the early 2000s. However, the most recent figures again show rising federal (and general) government deficits in Austria in 2004 and 2005, and the hypothesis of another structural break cannot be confirmed statistically as the period 1999/2000 to 2003 is too short to allow for testing with annual data.

GENERALIZED FLOOD-GARBER TEST

For estimating equation (8), we assume that expectations about future budgetary surpluses can be formed on the basis of surpluses of past years. To eliminate serial correlation in the residuals, lagged values of public debt are included as additional regressors. The equation to be estimated can then be written as

$$b_t = c_0 + A_0 \prod_{j=1}^{t} (1 + r_j) + c_1 b_{t-1} + ... + c_p b_{t-p} + a_0 s_t + a_1 s_{t-1} + ... + a_p s_{t-p} + \varepsilon_t \,. \qquad (9)$$

The so-called generalized Flood-Garber test (Flood and Garber, 1980) starts from equation (9). The null hypothesis for the test is A_0=0. If this condition is fulfilled, the series of public debt is stationary. Estimating equation (9) by OLS yields the results shown in Table 1, Est. (1). The estimated model shows that the coefficient A_0 is significantly positive (t-statistic 2.59). Thus, the null hypothesis seems to be rejected, and this first test favors the conclusion that discounted federal government debt is not stationary. But this result is not robust: In order to reduce serial correlation in the residuals, Est. (2) of Table 1 shows the results of an estimation including two AR-terms (using nonlinear least squares). Now the coefficient A_0 becomes insignificant with a t-value of 0.50.

Table 1. Stationarity of Austrian Federal Government Debt: Generalized Flood-Garber Test

	Est. (1) Coefficient (t-statistic)	Est. (2) Coefficient (t-statistic)	Est. (3) Coefficient (t-statistic)	Est. (4) Coefficient (t-statistic)	Est. (5) Coefficient (t-statistic)	Est. (6) Coefficient (t-statistic)
Constant	–0.6533				5.9900	33.5820
	(–3.1212**)				(5.3701**)	(1.9289(*))
A_0	0.1041	0.3410	–0.0206	0.1182	0.1439	-0.1260
	(2.5852*)	(0.5041)	(–0.1891)	(2.7448*)	(0.8316)	(-0.1672)
s_t	–1.0931	–1.1342	–0.6728	–0.9998	–0.3842	–0.8153
	(–13.2522**)	(–6.1347**)	(–3.8425**)	(–13.9029**)	(–1.6010)	(–2.9183**)
s_{t-1}		–0.6090				
		(–3.5408**)				
s_{t-2}		–0.4614				
		(–2.6651*)				
b_{t-1}	0.9763		1.0010	0.9450		
	(54.8900**)		(10.1727**)	(39.7286**)		
AR(1)		1.8582			0.9540	1.2970
		(14.4309**)			(3.0817*)	(6.4566**)
AR(2)		–0.8599			–0.5907	–0.3650
		(–6.5281**)			(–2.1853(*))	(–1.9063(*))
Adj. R^2	0.9984	0.9963	0.5928	0.9951	0.5398	0.9912
Durbin-Watson	1.7166	1.9278	1.9102	1.2217	1.8523	1.3835
No. of observations	43	40	14	29	13	29
Period	1961–2003	1964–2003	1961–1974	1975–2003	1962–1974	1975–2003

OLS estimation; ** $p<0.01$, * $p<0.05$, (*) $p<0.1$

As Figure 1 shows, there might be a structural break in the series of real federal government debt and discounted real federal government debt. A Chow breakpoint test for Est. (1) indicates a structural break in the year 1975 (log-likelihood ratio 7.99(*)), but does not do so for Est. (2). To obtain more insights, we estimate both equations for the periods 1960–1974 and 1975–2003 separately.

Est. (3) to (6) of Table 1 show the results. For the first period, 1960–1974, the null hypothesis cannot be rejected as the coefficient A_0 is significantly different from zero neither in Est. (3) nor in (5). This means that the no-Ponzi-game condition may hold for the first period, i.e. discounted real federal government debt is stationary. For the second period, it is less clear whether the series of discounted real public debt is stationary as the coefficient A_0 is significantly positive in Est. (4) (t-statistic 2.74) but not in Est. (6). The coefficient of b_{t-1} is close to one if this variable is included, which points toward the possibility of a unit root in the series of real federal government debt. Thus the generalized Flood-Garber test applied on the basis of past developments of the Austrian budgetary surplus does not give clear-cut results but seems to indicate that Austrian federal budgetary policy may have been less sustainable in the period since 1975 than before.

RESTRICTED FLOOD-GARBER TEST

In order to obtain more evidence on the stationarity of Austrian public debt, we apply the so-called restricted Flood-Garber test introduced by Hamilton and Flavin (1986) and extended by Greiner and Semmler (1999). With the generalized Flood-Garber test, no restrictions are imposed on the parameters a_1, a_2, … in equation (9). However, if one assumes that the primary surpluses s_t follow an autoregressive process, the following system of two equations can be derived. The first equation (10) describes the autoregressive process, while the second one (equation (11)) results from inserting the expected value of s_t derived from the first equation into equation (9).

$$s_t = c_1 + c_2 s_{t-1} + c_3 s_{t-2} + c_4 s_{t-3} + \varepsilon_{2t} , \qquad (10)$$

$$b_t = A_0 \prod_{j=1}^{t} \left(1 + r_j\right) + c_5 + \frac{\left(c_2 a + c_3 a^2 + c_4 a^3\right) s_t}{\left(1 - c_2 a - c_3 a^2 - c_4 a^3\right)} + \frac{\left(c_3 a + c_4 a^2\right) s_{t-1}}{\left(1 - c_2 a - c_3 a^2 - c_4 a^3\right)} + \frac{\left(c_4 a\right) s_{t-2}}{\left(1 - c_2 a - c_3 a^2 - c_4 a^3\right)} + \varepsilon_{1t} . \qquad (11)$$

For the restricted Flood-Garber test, equations (10) and (11) are estimated simultaneously by nonlinear least squares (SUR, seemingly uncorrelated regressions).

The term $a = 1/(1+r)$ denotes the discount factor for one period, with *r* being the average real rate of interest. The average real interest rate for the whole period (1960–2003) amounted to 3.42%. However, interest rates (and GDP growth) differed between the two periods. In period 1960–1974, real interest rates were 2.83 % on average while in the second period, 1975–2003, real interest rates were 3.73 %.

Table 2 shows the results of the simultaneous estimation of equations (10) and (11). The null hypothesis of the restricted Flood-Garber test is again A_0=0. The estimations for the whole period (1960–2003) as well as for the second period (1975–2003) yield coefficients for A_0 that are highly significantly different from zero. For the whole period, the t-statistic for A_0 is 19.35 (Table 2, Est. (7)), while for the second period, the t-statistic is 9.81 (Table 2, Est. (9)). The results for the first period (1960–1974) are reported in Table 2, Est. (8) and show a coefficient of A_0 that is much smaller and just significant at the 5 percent level (t-statistic: 2.13).

Table 2. Stationarity of Austrian Federal Government Debt: Restricted Flood-Garber Test

	Est. (7)	Est. (8)	Est. (9)
	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
c_1	-0.8050	-0.2394	-0.0616
	(-2.1178*)	(-2.5313*)	(-0.3881)
c_2	1.1782	0.3427	1.1433
	(1.9258(*))	(1.3289)	(4.7868**)
c_3	-0.2164	-0.7534	-0.3323
	(-0.2447)	(-3.2502**)	(-0.9502)
c_4	-1.5012	-0.0753	0.0246
	(-2.4559*)	(-0.3080)	(0.0988)
c_5	-2.5250	5.5025	9.4498
	(-2.0280**)	(8.0287**)	(5.5437**)
A_0	1.9592	0.2247	1.2023
	(19.3540**)	(2.1269*)	(9.8064**)
$\overline{R}^2$ Equation 10	0.7049	0.2104	0.7350
$\overline{R}^2$ Equation 11	0.8304	0.1349	0.7421
No. of observations	42	13	29
Period	1962–2003	1962–1974	1975–2003

SUR (NLS) estimation; ** p<0.01, * p<0.05, (*) p<0.1

The results of the restricted Flood-Garber test give a stronger indication for Austrian federal government debt being closer to stationarity for the period before 1975 than from 1975 on. H_0 is clearly rejected for the second period, indicating that discounted real federal government debt was not stationary over the period 1975–2003.

Unit Root Tests

Tests for Stationarity of b_t

Next, three unit root tests, the augmented Dickey-Fuller test (ADF test), the Phillips-Perron test (PP test) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, are applied to test for stationarity in some time series of Austrian budgetary policies. The ADF test takes the first difference of a time series as the dependent variable and regresses it on the lagged values of the same time series and on one or more lagged first differences of the series. Furthermore, a constant and a linear trend can be included as explanatory variables. If the time series has a unit root and hence is non-stationary, the estimate for the coefficient of the lagged series is non-negative. If the estimator is significantly negative, the null hypothesis H_0 – i.e. the hypothesis that the time series has a unit root[1] – has to be rejected. In order to apply the ADF test to the time series b_t, the following equation has to be estimated:

$$(b_t - b_{t-1}) = \beta_0 + \beta_1 b_{t-1} + \beta_2 (b_{t-1} - b_{t-2}), \tag{12}$$

where the βs are the coefficients to be estimated. An alternative to the ADF test is the Phillips-Perron test (PP test). This test does not include the lagged first difference $(b_{t-1} - b_{t-2})$ but adjusts the value of the t-statistic for serial correlation in the residuals. Another test for the presence of a unit root is the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. In contrast to the ADF and PP tests, this method can be applied to test the null hypothesis of stationarity against the alternative of the presence of a unit root (non-stationarity). The power of all these tests is limited for the small number of observations available for our time series; hence we want to check for the robustness of the results by applying all three test statistics.

Table 3 shows the results of the ADF, PP and KPSS tests in different specifications. For the whole period, all of the test procedures indicate that discounted public debt is non-stationary. For the sub-periods, the results are inconclusive: The ADF and PP tests cannot reject the unit root hypothesis for the first period but do so for the second period. On the other hand, the KPSS test statistic in Est. (12) does not reject the null hypothesis of stationarity for the first period but does so for the period 1975–2003 at the 5 percent significance level.

Table 3. Stationarity of Austrian Federal Government Debt b_t: Unit Root Tests

	Est. (10)	Est. (11)	Est. (12)
ADF test statistic	–1.1136	–2.6512	–4.7381**
PP test statistic	–0.5958	–2.2740	–5.0617**
KPSS test statistic	0.7390**	0.2579	0.6334*
No. of observations	42	13	29
Period	1962–2003	1962–1974	1975–2003

Description: ** p<0.01, * p<0.05, (*) p<0.1

The results in Table 3 seem to indicate that the discounted real federal government debt is non-stationary for the whole period 1962–2003, which seems astonishing, but on the other hand these tests are known to be not very powerful. The KPSS test suggests that 1962–1974 may be stationary and hence public debt was sustainable, but for 1975–2003 this may not be the case, which seems more plausible when inspecting the data. Summing up, the results for the sub-periods are rather inconclusive.

Tests for Stationarity of s_t

In order to further test the stationarity of Austrian public debt, we consider the stationarity of the federal budget primary surplus. As Trehan and Walsh (1991) have shown, a stationary discounted primary surplus is a necessary and sufficient condition for stationarity of the series of discounted public debt, provided that the expected real interest rate is constant.

In order to test for the non-stationarity of the discounted real primary surplus s_t, the following equation was estimated:

$$(s_t - s_{t-1}) = \left[\beta_0\right] + \beta_1 s_{t-1} + \beta_2 (s_{t-1} - s_{t-2}) + \left[\beta_3 Trend\right]. \qquad (13)$$

Table 4 shows the results for several unit root tests for s_t. The hypothesis of non-stationarity cannot be rejected for the whole period by the ADF and PP tests (Est. (13)) and the second period (Est. (15)). For the first period (Est. (14)), the ADF test rejects non-stationarity at the 5% level of significance (the ADF test statistic is –4.03). The respective results for the PP tests also indicate that the hypothesis of non-stationarity of the series of the discounted real primary surplus cannot be rejected at any reasonable level of significance for all specifications (except possibly for the period 1962–1974). On the other hand, the KPSS test results give some hint of stationarity for the whole period, but not for the sub-periods. In the period 1975–2003, as with ADF and PP, the series is indicated as being non-stationary.

Table 4. Stationarity of Austrian Federal Government Primary Surplus s_t: Unit Root Tests

	Est. (13)	Est. (14)	Est. (15)
ADF test statistic	–2.3472	–4.0291*	–1.5745
PP test statistic	–1.8656	–2.1319	–1.1153
KPSS test statistic	0.3300	0.3855(*)	0.6304*
No. of observations	42	13	29
Period	1962–2003	1962–1974	1975–2003

Description: ** p<0.01, * p<0.05, (*) p<0.1

Tests for Stationarity of si_t

Another test on the stationarity of Austrian federal government debt proceeds by testing the stationarity of the real federal budgetary surplus including interest payments, si_t, i.e. the real (net) budget surplus. Trehan and Walsh (1991) have also shown that the stationarity of si_t is a sufficient condition for the stationarity of public debt b_t with positive (not necessarily constant) real interest rates.

The stationarity of si_t is again tested by applying the ADF, the PP and the KPSS tests as before. Table 5 shows the results for si_t.

Table 5. Stationarity of Austrian Federal Government Budget Surplus si_t: Unit Root Tests

	Est. (16)	Est. (17)	Est. (18)
ADF test statistic	–2.4014	–3.7403*	–2.1612
PP test statistic	–1.7415	–1.9895	–1.7094
KPSS test statistic	0.3294	0.4151(*)	0.3765(*)
No. of observations	42	13	29
Period	1962–2003	1962–1974	1975–2003

Description: ** p<0.01, * p<0.05, (*) p<0.1

The picture is very similar to the one obtained for the primary surplus: for no period, the ADF and PP tests reject the null hypothesis of non-stationarity at a reasonably high level of significance, the only possible exception being the ADF for the first period, hence the federal budget surplus seems to be characterized by a unit root. The KPSS tests again give different results: no indication of a unit root for the total sample, rejection of stationarity for the two sub-periods at the 10 percent significance level. Only for the second sub-period do all tests consistently indicate non-stationarity.

Summing up the tests on stationarity in the series of real federal government public debt, primary surplus and net budget surplus, with the possible exception of the period up to 1974, we did not find much evidence that some of the time series are stationary, i.e. that the Austrian budgetary policy was sustainable in the long run in the strong sense as defined above.

ARMA PROCESSES

Hamilton and Flavin (1986) criticized the tests applied so far regarding stationarity of the time series as being too restrictive. Following their arguments, Wilcox (1989) assumed an ARMA process for discounted public debt of the following form:

$$(1-\rho(L))((1-L)^d b_t - \alpha_0) = (1-\theta(L))e_t\,, \tag{14}$$

where α_0 is the unconditional expected value of the stationary time series $(1-L)^d b_t$. In order to follow a strongly sustainable budgetary policy, b_t has to be stationary, i.e. d and the unconditional expected value of b_t have to be equal to zero (α_0=0).

The unit root tests applied in the previous subsections have mostly shown that the null hypothesis of non-stationarity of Austrian public debt cannot be rejected. However, these tests are not very selective. In order to apply additional tests for stationarity of Austrian public debt, we hypothesize that describing the time series of discounted real public debt b_t with an ARMA process is adequate and that the series is stationary.

We test for several specifications according to the following approach. We start with a more general specification in the form of an ARMA (3, 3) process and then eliminate all terms which are not significant at the 10% significance level. We first try to estimate an ARMA process for the whole period and then separately for the first and second period. Table 6 shows the results.

Table 6. Stationarity of Austrian Federal Government Debt b_t: ARMA Processes

	Est. (19) Coefficient (t-statistic)	Est. (20) Coefficient (t-statistic)	Est. (21) Coefficient (t-statistic)
Constant	21.3277	6.9760	30.5677
	(4.1057**)	(57.9981**)	(16.3865**)
AR(1)	1.9852		0.8757
	(30.2481**)		(35.0219**)
AR(2)	-0.9952		
	(14.4468**)		
MA(1)	–0.7542	0.9899	0.5369
	(–3.5072**)	(51519.11**)	(3.3209**)
MA(2)	–0.6098		
	(–2.9676**)		
Adj. R²	0.9956	0.6257	0.9903
Durbin-Watson	2.2324	1.3644	1.8835
No. of observations	42	15	29
Period	1961–2003	1960–1974	1975–2003

OLS estimation; ** p<0.01, * p<0.05, (*) p<0.1

As mentioned above, stationarity of the series of federal government debt requires that the term α_0 is not significantly different from zero. Est. (19) in Table 6 shows the result of estimation for the whole period. Looking at the characteristic equation of the AR-part of this equation shows that it is statistically indistinguishable from a unit root process, implying possible non-stationarity of this process. For the first period of 1960 to 1974, the unconditional expected value is estimated to be 6.98 with a high t-value of 58.0 (Est. (20), Table 6). However, the period includes only 15 observations and the resulting MA specification is statistically not very attractive, hence the result of non-stationarity is not too reliable. Est. (21) shows that the intercept is much larger for the second period (1975–2003) and significantly positive with a value of 30.57 (t-value 16.39). This result may be interpreted to mean that Austrian fiscal policy was less sustainable in the second than in the first period.

5. Bohn's Sustainability Test

In the previous section, the stock of discounted real federal government debt and the different budget surplus measures were tested for stationarity. The tests show a slight tendency towards stationarity in the first period (1960–1974), while the series does not seem to be stationary in the second period but rather follows some kind of growth process. A conclusion which could be derived from such tests is that Austrian fiscal policy has not been sustainable since 1975. However, all tests applied so far are based on assumptions about the "adequate" discount rate. Variations in the discount rate might alter the results as discounted public debt is very sensitive with respect to the interest rate used for discounting. Such a sensitivity of results is a major disadvantage of the stationarity tests applied in the sections above. In addition, as Bohn (2006) points out, when using some (more or less arbitrary) rate of discount, one is testing "ad hoc sustainability" instead of public debt sustainability based on the true intertemporal budget constraint.

The present section provides the results of testing sustainability of Austrian federal government debt with a methodology developed by Bohn (1998) in the context of US fiscal policy. This methodology does not rest on assumptions about the discount rate. For such an approach, the following equation is estimated:

$$ps_t = \rho\, d_{t-1} + \alpha_0 + A\, Z_t + \varepsilon_t, \qquad (15)$$

where ps_t denotes the primary surplus of period t, d_t is the stock of central government debt in period t, and Z_t is a vector of additional variables influencing the budgetary surplus. For example, Barro (1979) included deviations of GDP and of public expenditures from their trend, which proved, however, not to be significant for

Austrian data. All variables are measured as ratios to GDP (in %; primary surplus-to-GDP ratio, debt-to-GDP ratio). Bohn has shown that fiscal policy is sustainable if equation (15) mirrors a mean-reverting process. In this case, we require ρ to be significantly positive, indicating that fiscal policy-makers react to an increased stock of debt at the beginning of period *t* by increasing the primary surplus (reducing the primary deficit) in period *t*. This is a sufficient condition for "true" sustainability of the debt process d_t (see also Bohn, 2006).

As a first step before empirically estimating equation (15), we apply the ADF and PP methodology to test whether the primary surplus-to-GDP ratio has a unit root. We cannot reject the hypothesis of a unit root at the 1% significance level, while at the 5% (ADF test) and 10% (PP test) levels, we can reject the hypothesis of a unit root. This is again an inconclusive result; hence t-tests suffer from a possible bias towards rejecting null hypotheses too easily. Nevertheless, for the following results, we denote significance as being (??) when the t-distribution holds (stationarity); however, most t-values are high enough to indicate significance under the Dickey-Fuller distribution as well.

Table 7 shows several estimations of equation (15). As it turns out that an estimation of equation (15) without accounting for the structural break in 1974/1975 is not correctly specified, we start with Est. (22), which adds a dummy variable *D75* as an additional regressor (*D75* = 1 for the period 1975–2003, 0 otherwise). Here, the process exhibits clear mean reversion for the whole period, but the effect seems to be small. The size of the ρ coefficient of equation (15) implies that ceteris paribus in Austria, an additional federal debt of EUR 100 leads to an increase in the primary surplus in the following year by EUR 9.2. The other variables included by Bohn and in the specifications by Barro (1979, 1986), which are derived from the tax-smoothing theory, have no significant influence. In Haber and Neck (2006), we examine additional variables for explaining the primary surplus; these do not change the order of magnitude of the effects resulting from the estimates given in Table 7.

Table 7. Bohn's Sustainability Test for Austria (dependent variable: primary surplus of the federal government budget, ratio to GDP)

	Est. (22)	Est. (23)	Est. (24)	Est. (25)	Est. (26)
	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
Constant	–1.2994	–4.5370	–4.8030	–4.5310	–4.3674
	(–5.3935**)	(–10.9527**)	(–2.5471*)	(–9.6434**)	(–8.2148**)
d_{t-1}	0.0918	0.3703	0.3883	0.0912	0.3408
	(9.5209**)	(9.3436**)	(2.4308*)	(8.6440**)	(6.7717**)
D75 (=1 for period after 1974)	–3.2555				
	(–8.3368**)				
$d_{t-1} \cdot D75$		–0.2790			–0.2531
		(–8.6395**)			(–6.0876 **)
AR(1)					0.8784
					(6.0885**)
AR(2)					–0.3915
					(–2.6571*)
$\bar{R}^2$	0.6823	0.6964	0.2596	0.7247	0.8438
F-statistic	47.1695	50.3163	5.9088	74.7195	56.3683
Durbin-Watson	0.8077	0.7766	1.5973	0.5924	1.8190
No. of observations	44	44	15	29	42
Period	1960–2003	1960–2003	1960–1974	1975–2003	1962–2003

OLS estimation; ** p<0.01, * p<0.05, (*) p<0.1

Multiplying the dummy variable for the period starting in 1975 with the coefficient for the debt-to-GDP ratio d_t instead of the constant (i.e. splitting the reaction coefficient instead of the constant) adds further explanatory power to the model (Est. (23)). This result indicates that the reaction of fiscal policy-makers (increasing the primary surplus upon increased public debt) was significantly lower in the second period than in the first. While until 1974, an increase in public debt of EUR 100 led ceteris paribus to an increase in the primary surplus by around EUR 37, this reaction decreased to around EUR 9 on average from 1975 onward. A similar result for the estimates for d_{t-1} can be derived by separately estimating the fiscal policy's reaction for the two periods (Est. (24) and (25) in Table 7).

The estimations (23)–(25) still face problems with autocorrelation of the residuals. Thus, the model was re-estimated including two AR terms (Cochrane-Orcutt procedure). Est. (26) shows that the coefficients of d_{t-1} and $d_{t-1} \cdot D75$ remain roughly the same as before. The sign and size of the coefficients indicate that the process of the development of primary surplus has a clear mean-reverting tendency in the first period (1960–1974); that tendency still exists but is much weaker in the second period (1975–2003).

The coefficient for d_{t-1} (i.e. ρ in equation (15)) can be interpreted as follows (cf. Bohn, 1998). Assuming stationarity of ps_t, the debt-to-GDP ratio should follow a stationary, mean-reverting process if $\bar{x}(1-\rho)<1$. $\bar{x}$ is the ratio of the average real interest rate $\bar{r}$ (approximated by the average return on long-term non-government bonds) to the growth rate of real GDP, $\bar{y}$. $\bar{x}$ can be approximated by $\bar{x} \approx 1+\bar{r}-\bar{y}$.[2]

As mentioned before, in the first period (1960–1974), the average real interest rate was 2.82%, while real GDP grew by 4.68%. Thus, $\bar{x}$ would amount to 0.98. According to the above condition for stationarity of the public debt-to-GDP ratio, $\bar{x}(1-\rho)<1$ means 0.65 < 1; this leads to the conclusion that d_t was stationary in the first period and thus fiscal policy was sustainable.

In the second period, $\bar{x}$ = 1.0149. Inserting $\bar{x}$ in the above equation and accounting for an estimated ρ of 0.088 for the second period (see Est. (26)) leads to 0.93 < 1. The calculated measure comes closer to the critical value of 1, but does not surpass it. This indicates that in the second period, d_t still followed a mean-reverting process, but the coefficient of mean-reversion was quite small. From this, we can conclude that fiscal policy may still have been sustainable in this period, but the policy reaction to ensure sustainability was much weaker than before the first oil price shock that hit

Austria in 1975. A strong conclusion about sustainability in this period cannot be drawn from these calculations as the stationarity of the primary surplus variable ps_t is doubtful in the period 1975–2003.

6. Summary and Conclusions

The following conclusions can be drawn from the description of Austrian fiscal policies and the econometric exercises applied to test for the sustainability of public debt in Austria. We identify a significant structural break in the mid 1970s in the development of fiscal policy. From the early 1960s to 1974, the debt-to-GDP ratio was stable at around 10 to 12%, while from 1975 to 2003 it increased at an average annual rate of about 2.5 percentage points, culminating at more than 60% in the last few years. Since 1995, the ratio has been rather stable again. It seems that with the first oil price shock, fiscal policy-makers changed their paradigm: While in the first period, stabilizing public debt was a major task (which could be more easily achieved due to high GDP growth rates and low unemployment), the major policy goal in the second period, which was characterized by lower growth and higher (and rising) unemployment, seems to have been lowering the rate of unemployment, at the cost of high federal budget deficits and thus increasing federal government debt.

The paradigm shift in fiscal policy can also be shown econometrically by testing the stationarity of the discounted public debt and primary surpluses. While there is some evidence for stationarity in the first period (1960–1974), in the second period (1975–2003) discounted public debt has clearly been following some kind of growth process. Although the unit root tests do not conclusively reveal non-stationarity of discounted public debt for the second period in all cases, estimations based on the generalized and restricted Flood-Garber tests show some indications of a non-stationary growing public debt. According to these econometric tests, Austrian fiscal policy may not have been (strongly) sustainable in the period from 1975 onward.

As these econometric tests rest on assumptions about an appropriate discount rate, we also follow an approach to explore the sustainability of Austrian fiscal policy that does not depend on any particular discount rate. Sustainability of fiscal policy is tested by exploring policy-makers' reactions to increases in public debt. If policy-makers increase the primary surplus sufficiently as a reaction to increased public debt, fiscal policy can be considered sustainable. While there is a clear mean-reverting tendency in the first period until 1974, the policy-makers' reaction to growing public debt is much smaller (but still positive) in the second period. After the first oil price shock, unemployment may have played a more significant role as a policy objective in the sense of a counter-cyclical orientation of "Austrokeynesian" fiscal policy. Due to the low number of observations available since Austria's entry into the EU in 1995 or since the start of the "center-right" coalition government in 2000, it is not yet possible to identify another possible structural break due to a higher weight being given to public debt sustainability.

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[1] Hypothesis H_0 of the ADF and PP tests states the opposite of the Flood-Garber test: here, H_0 postulates *non*-stationarity of the series. If the estimation results in an insignificant estimator of the coefficient, one cannot conclude that the time series is non-stationary (i.e. that H_0 is confirmed).

[2] While the econometric tests are not based on assumptions about the "appropriate" discount rate, assessing the sustainability of fiscal policy in such a way again needs some measure of the "appropriate" real interest rate. However, as Bohn (2006) shows, fulfilling $\rho > 0$ in an appropriately

specified reaction function (15) is sufficient for public debt sustainability irrespective of the above interpretation.

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