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Working Paper

Sustainability of Swiss fiscal policy

CESifo Working Paper, No. 1689

Provided in Cooperation with:

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Suggested Citation: Kirchgässner, Gebhard; Prohl, Silika (2006) : Sustainability of Swiss fiscal policy, CESifo Working Paper, No. 1689, Center for Economic Studies and ifo Institute (CESifo), Munich

This Version is available at:

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SUSTAINABILITY OF SWISS FISCAL POLICY

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CESIFO WORKING PAPER NO. 1689

CATEGORY 1: PUBLIC FINANCE

MARCH 2006

PRESENTED AT CESIFO AREA CONFERENCE ON MACRO, MONEY
& INTERNATIONAL FINANCE, FEBRUARY 2006

An electronic version of the paper may be downloaded

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SUSTAINABILITY OF SWISS FISCAL POLICY

Abstract

We examine whether Swiss federal fiscal policy was sustainable over the period from 1900 to 2002. We perform unit root and cointegration tests for federal revenues and expenditures, taking into account a structural shift in the budgetary process related to World War II. We find sustainability over the entire period. However, splitting the sample into two sub-samples before and after World War II, the results do much less support sustainability. Finally, applying the tax smoothing model of BARRO (1979), we show that cyclical fluctuations of the output and changes in expected inflation rate are major determinants of the federal budget deficit over the time period considered.

JEL Code: H62, H63.

Keywords: sustainability, budget deficit, cointegration, structural breaks.

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We are grateful for helpful comments and suggestions by ULRICH MÜLLER and FRIEDRICH SCHNEIDER. We gratefully acknowledge financial support from the Research Commission of the University of St. Gallen. We thank ELBETH ETTER, DR. CARSTEN COLOMBIER and ALAIN GEIER (Swiss Federal Finance Administration), ROLF BEYERLER and GILDBERT VEZ (Swiss Federal Statistical Office) as well as STEFANIE SCHNYDER (Swiss National Bank) for helping us in compiling the data.

- Preliminary Version, February 2005.

1 Introduction

The recent deterioration of the fiscal position of governments in several European countries and the U.S. has drawn attention to the long-run fiscal sustainability of public finance. Several theoretical approaches have been developed to analyse whether the government can manage the budget deficit in the long-run. The seminal paper by DOMAR (1944) does not use the term sustainability but implicitly defines it as a constant long-run relation between total public debt and GDP: public debt may grow but it should not grow faster than GDP. This allows for a permanent public deficit, but it should also not grow faster than GDP.

While DOMAR (1944) considers the steady-state long-run equilibrium, more recent approaches look at the intertemporal budget constraint. The rather popular *Generational Accounting Approach* introduced by AUERBACH, GOKHALE and KOTLIKOFF (1991, 1992) defines it in terms of net fiscal burden of current and future generations. This implies that fiscal policy is sustainable whenever the net debt of the government does not exceed the sum of the discounted net taxes which should be paid by current and future generations.¹⁾

Another concept which is more closely related to DOMAR (1944) defines fiscal policy as sustainable if the present value budget constraint of the government is valid: the discounted value of public debt should converge to zero at the limit. This implies that current and discounted future surpluses must be sufficient to payoff the current public debt. Following this view, several econometrical tests developed in the empirical literature. One line proposes that the stationarity of the public debt indicates the long-run sustainability of the fiscal policy. Assuming constant interest rates, HAMILTON and FLAVIN (1986) test for the stationarity of undiscounted public debt and show that the U.S. fiscal policy is consistent with the present-value budget constraint. If the discounted debt series is used, WILCOX (1989), however, shows that U.S. fiscal policy violates the intertemporal budget constraint. Another direction taken in the empirical literature which uses modern time series methods assumes sustainability to be given when the budget deficit and public debt are co-integrated. McDONALD (1992) employs such a co-integration test and shows that U.S. fiscal policy is not sustainable. An alternative framework implies that fiscal policy is sustainable if government revenues and expenditures are co-integrated with a co-integrating vector $[1 \ -1]$. TREHAN and WALSH (1988), HAUG (1995), AHMEND and ROGERS (1995), and QUINTOS (1995) test for sustainability by checking for the co-integration between the government revenues and expenditures and show that the U.S. federal budget deficit is not sustainable. Furthermore, they find that recent changes in the structure of fiscal policy had a significant effect on sustainability of the U.S. federal finance. Several studies find structural breaks in the U.S. federal deficit in the mid-seventies or early eighties which had a significant impact on budget sustainability.²⁾ QUINTOS (1995), e.g., finds

1. A similar approach has been proposed by BLANCHARD et al. (1990) and BLANCHARD (1993) and is employed by the OECD. See, e.g., OECD (2002).

2. See, e.g., HAMILTON and FLAVIN (1986), WILCOX (1989), HAKKIO and RUSH (1991) as well as QUINTOS, (1995).

that legislative tax changes in the U.S. in the early eighties like, e.g., the Kemp-Roth tax cut, had a significant impact on the sustainability of the federal budget deficit. Splitting the sample into two sub-periods and assuming that there was a structural shock in the early eighties, she shows that the U.S. federal budget deficit was sustainable during the pre-break period but violates the intertemporal budget constraint in the post-break sub-period.

While the Generational Accounting Approach has been applied to Swiss data,³⁾ this paper is the first one to use time series methods to test for sustainability of the Swiss fiscal policy. We consider the period from 1900 to 2002 and ask whether fiscal policy was consistent with the intertemporal budget constraint. However, due to the long time-horizon it is necessary to take into account possible structural changes in the fiscal policy due to, e.g., the World Wars, the Great Depression, and legislative changes in the budgetary process etc. Thus, we look for shifts in the Swiss federal budget process which are relevant for the assessment of its sustainability.

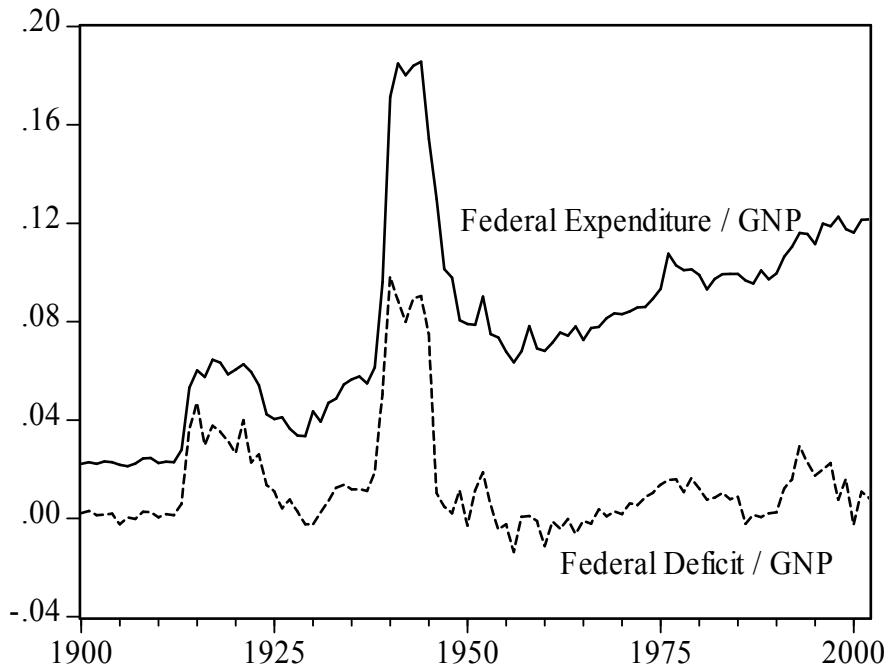


Figure 1: Swiss federal expenditure and deficit in relation to GNP, 1900 – 2002

That fiscal sustainability may also be a Swiss problem can be seen from a visual examination of the historical development over the last 100 years. *Figure 1* shows federal expenditure and deficit over the period 1900-2002. The fiscal position of the federal government worsened substantially during both World Wars. However, the upward spike in the deficit is much more pronounced during World War II. After this war, expenditure (as a share of GNP) increased considerably, while the deficit did not show a clear picture. The development of the federal debt, as shown in *Figure 2*, on the other hand, gives a clearer picture. After the war public

3. See, e.g., BORGMAN and RAFFELHÜSCHEN (2004) or KOMMISSION FÜR KONJUNKTURFRAGEN (2004).

debt which was accumulated during the war declined until the mid sixties, and then increased again, especially during the nineties. The nominal federal public debt increased from 38.5 billion CHF in 1990 to 122.9 billion CHF in 2002, which implies an increase of 173 percent if measured in real terms. As a consequence, the Swiss constitution was amended by a debt brake through a referendum in December 2001, which is planned to become fully effective from 2007 onwards, and which – somewhat simplified – is operating in the following way:⁴⁾ Expenditure have to be adjusted to the revenue which, however, is smoothed over the business cycle. In calculating this smoothed revenue extraordinary revenue is not considered; it has to be used to pay back debt. ‘Normal’ surpluses and deficits are accounted in a separate account and they are to be balanced over several years. Deficits which exceed 6 percent of the expenditure of the preceding year have to be balanced within the next three years. Extraordinary expenditure (which are not included in these calculations) can be decided on by the majority of the members in both Chambers of the Federal Parliament.

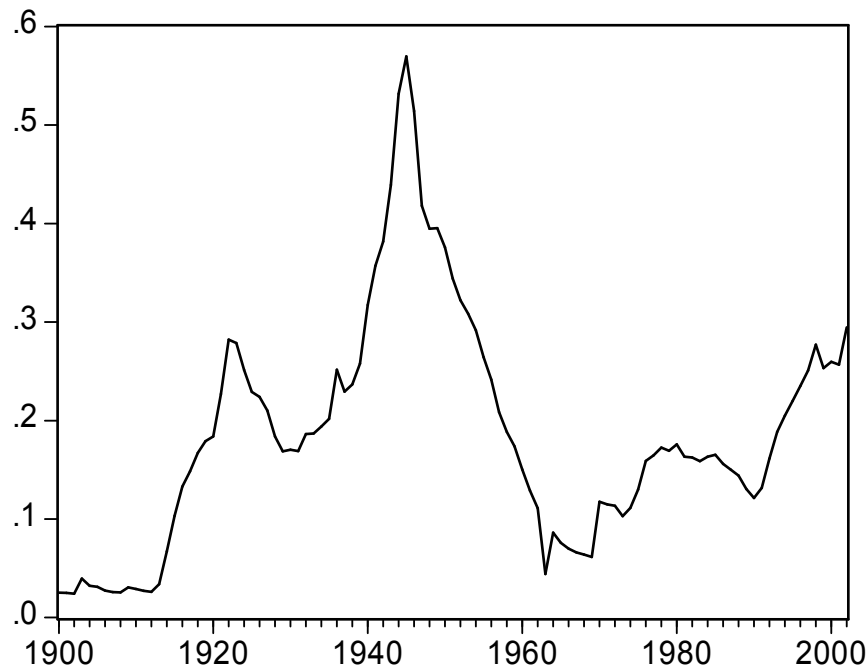


Figure 2: *Swiss federal debt in relation to GNP, 1900 – 2002*

The fact that not only this new instrument has been introduced but that a huge majority of 84.7 percent of the people voted in favour of this amendment indicates that at least the Swiss population had doubts about the sustainability of its federal fiscal policy. Moreover, the generational accounting analyses for Switzerland mentioned above clearly demonstrate the existence of a sustainability gap. The problem of these analyses is, however, that they use ex-

4. See also DANNINGER (2002) and – for more details – the legal documents: Bundesbeschluss über eine Schuldenbremse vom 22. Juni 2001 (BBl 2000, 4653) as well as Änderung des Bundesgesetzes über den eidgenössischen Finanzhaushalt vom 22. Juni 2001 (BBl 2000, 4728f., Entwurf.). See for this also: EIDGENÖSSISCHES FINANZDEPARTEMENT (2001) as well as BUNDESRAT (2000, 2001).

trapolations of the current situation and do not take into account that the current situation may not be an equilibrium. Consequently, starting with different base years the estimated sustainability gap may be quite different. The econometric approaches, on the other hand, try to look at the underlying long-run equilibrium relations and ask whether these relations imply sustainability. The disadvantage is that they might give too little weight to the most recent development (and too much to the no longer relevant past). Thus, the two approaches complement each other. As generational accounting analyses for Switzerland are available but no econometric analyses of this problem, this paper intends filling this gap.

Thus, with regard to the Swiss fiscal policy, the following two issues are the main concern of this study. Firstly, is the Swiss federal budget deficit consistent with the intertemporal budget constraint of the government? And are there changes in the Swiss fiscal history which might fundamentally shift the sustainable deficit process? Secondly, is it possible to explain the budget process by macroeconomic factors such as cyclical fluctuations of the economy or changes in inflation?

To answer these questions, we use a set of tests for cointegration between federal revenues and expenditures over the period from 1900 to 2002. Searching for structural changes in the budgetary process, we employ three different econometric strategies. We apply the PERRON (1989) unit root test with unknown structural breaks to the deficit, revenues and expenditures. Furthermore, we use the Chow-test which examines the stability of the parameters of the short-run relationship between revenues and expenditures. Additionally, we perform the GREGORY and HANSEN (1996) test in order to check for the presence of structural breaks in the long-run cointegration relationship between revenues and expenditures. Based on these findings, we apply the tax smoothing model of BARRO (1979, 1986) in order to analyse the macroeconomic determinants of the budgetary process. Foreshadowing our results, we find that the budget deficit is weakly sustainable over the entire period. Hence, we show that it exhibits a significant structural change during World War II which affected the structure of fiscal policy in the post-World War II sub-period. Splitting the entire sample into two subsamples, the results for both sub-periods do, however, much less support the assumption of sustainability.

This paper is organised as follows. *Section 2* presents the theoretical framework and the test approaches which have been developed. *Section 3* contains a discussion of the time series properties of the federal budget deficit, revenues and expenditures. Hence it presents and discusses the results of the unit root tests following the univariate test for sustainability of budget deficit, the test for structural breaks, and deals with the tests for co-integration between revenues and expenditures. After performing these tests, *Section 4* examines the relevant determinants of the federal budget deficit. In *Section 5* we finally discuss how the seemingly contradictory results for the entire period and the two sub-periods might be interpreted.

2 The Theoretical Framework

The theoretical model of sustainability of budget deficit is based on the static and intertemporal budget constraint of the government. The static budget constraint (in nominal terms) is given by

$$(1) \quad G_t + (1 + r_t) TD_{t-1} = R_t + TD_t,$$

where TD_t represents the stock of public debt, while r_t denotes the ex-post interest rate for public debt, R_t represents government revenues and G_t expenditures excluding interest payments (at time t). In order to simplify the model, we do not explicitly consider the revenue from seignorage.

Assuming that equation (1) holds for each period, we obtain the intertemporal budget constraint by performing the forward substitution as

$$(2) \quad TD_t = \sum_{n=1}^{\infty} \left[\prod_{j=1}^n \frac{1}{(1 + r_{t+j})} (R_{t+n} - G_{t+n}) \right] + \lim_{n \rightarrow \infty} \prod_{j=1}^n \frac{1}{(1 + r_{t+j})} TD_{t+n}.$$

By assuming a constant interest rate r the present-value budget constraint (PVBC) of the government is given by

$$(2a) \quad TD_t = \sum_{n=1}^{\infty} \left[\frac{1}{(1 + r)^{n+1}} (R_{t+n} - G_{t+n}) \right] + \lim_{n \rightarrow \infty} \frac{1}{(1 + r)^{n+1}} TD_{t+n}.$$

Whether fiscal policy is sustainable depends on the development of the second term of this equation. If the transversality condition

$$(3a) \quad \lim_{n \rightarrow \infty} \frac{1}{(1 + r)^{n+1}} TD_{t+n} = 0$$

holds, the present value budget constraint of the government is given by

$$(3b) \quad TD_t = \sum_{n=1}^{\infty} \left[\frac{1}{(1 + r)^{n+1}} (R_{t+n} - G_{t+n}) \right].$$

Condition (3a) is known as the ‘no Ponzi game’ rule for public debt, it states that the growth rate of public debt should not be larger than the real interest rate. Under the usual assumption that the real interest rate is larger than the real growth rate of the economy, this is a *necessary* and *sufficient condition* for fiscal policy to be sustainable.⁵⁾ It requires that current and dis-

5. If the real growth rate is larger than the real interest rate, (3a) it is sufficient but not necessary for fiscal policy to be sustainable. Following the (implicit) DOMAR (1944) definition that fiscal policy is sustainable whenever the long-run relation between government debt and GDP is constant, the growth rate of public

counted future surpluses must be sufficient to pay-off the current public debt. If this requirement is satisfied then the fiscal policy of the government is consistent with the present value budget constraint.

Several methods have been developed to test whether the fiscal policy of government is sustainable. One direction of the studies checks whether the data are consistent with the transversality condition by examining the stationarity properties of the budget deficit excluding interest payments of public debt. Assuming a constant real interest rate and starting with relation (3) as null hypothesis, HAMILTON and FLAVIN (1986) take

$$(4) \quad E_t \left[\lim_{n \rightarrow \infty} \frac{1}{(1+r)^n} TD_{t+n} \right] = A_0 > 0$$

as an alternative. Inserting this into (2a) and rearranging it leads to

$$(5) \quad TD_t = E_t \left[\sum_{n=1}^{\infty} \frac{S_{t+n}}{(1+r)^{n+1}} \right] + A_0 (1+r)^t$$

where S_t represents the primary surplus. HAMILTON and FLAVIN (1986) argue that a *sufficient condition* for the validity of the present value budget constraint is the stationarity of the primary deficit. If $A_0 = 0$ in equation (5), then they expect that public debt is stationary.

Using annual U.S. data for the period from 1962 to 1984, they apply the Augmented Dickey-Fuller test to the budget deficit series and show that the levels of public debt and the primary deficit are stationary. Based on these findings, they suggest that the U.S. federal government budget is balanced in the present-value terms.

However, there have been raised several critical issues concerning the hypothesis and the results presented in this study. WILCOX (1989) uses the same data to show evidence that the hypothesis developed by HAMILTON and FLAVIN (1986) is incorrect. He demonstrates that the present value budget constraint may be satisfied even if the level of the primary deficit is non-stationary. He uses two lines of arguments. Firstly, he questions the assumption about the constant real interest rate. Hence, he modifies the test of HAMILTON and FLAVIN (1986) and defines the sustainable budget policy in a way that the discounted value of public debt converges to zero. He allows for a time-varying real interest rate, discounts the debt series back to the starting period, and applies the ADF-test to discounted series. He comes to the conclusion that, over the entire period from 1960 to 1982, U.S. fiscal policy is not sustainable, i.e. it violates the present value budget constraint.⁶ Secondly, he asks whether the sustainability of fiscal policy exhibits significant structural breaks and splits the sample into two sub-samples: the pre 1974- and post 1974-sub-periods. He finds that fiscal policy of the U.S. federal gov-

debt may well be higher than the real interest rate whenever the latter is below the long-run growth rate of the economy.

6. KREMERS (1988, 1989) as well as TREHAN and WALSH (1988) draw similar conclusions.

ernment was not sustainable in the second sub-period, and he points out that non-sustainability of the budget deficit came into effect in the latter period.

An equivalent to HAMILTON and FLAVIN's (1986) test for intertemporal budget constraint requires a test for co-integration between the public debt and budget deficit, given that these series are of the same order of integration. In order to derive the testable hypothesis that equation (3a) holds, MACDONALD (1992) rewrites (3b) as

$$(3b') \quad TD_t = E_t \left[\sum_{n=0}^{\infty} \frac{S_{t+n}}{(1+r)^{n+1}} \right]$$

After rearranging he gets

$$(6) \quad TD_t - \frac{1}{r} S_t = E_t \left[\sum_{n=0}^{\infty} \frac{\Delta S_{t+n}}{(1+r)^{n+1}} \right]$$

Condition (6) implies that the test for stationarity of ΔS_t is equivalent to the test for stationarity of $(TD_t - S_t/r)$. Thus, the sustainability condition requires the cointegration between S_t and TD_t with the cointegrating vector $[1 \ -r]$. To test this hypothesis, MACDONALD (1992) employs U.S. quarterly fiscal data for the period of the first quarter of 1951 to the last one of 1984. Applying the co-integration methods of ENGLE and GRANGER (1987) and of JOHANSEN (1988), he fails to find evidence for cointegration and concludes that the U.S. budget deficit is not consistent with the intertemporal budget constraint. Like WILCOX (1989), he assumes the presence of structural breaks and performs his analysis also for different sub-samples. He come to the conclusion that U.S. fiscal policy violates the present-value budget constraint in the sub-samples. The same result was reached by TREHAN and WALSH (1988) with an alternative test for the intertemporal budget constraint based on the co-integration between the deficit and public debt with annual data for the period from 1946 to 1987.

An alternative is to test for cointegration between revenues and expenditures. HAKKIO and RUSH (1991) propose to rewrite equation (2a) with total government expenditure (TG) on the left-hand side:

$$(7) \quad TG_t = G_t + r TD_{t-1} = R_t + \sum_{n=1}^{\infty} \left[\frac{1}{(1+r)^{n+1}} (\Delta R_{t+n} - \Delta G_{t+n}) \right] + \lim_{n \rightarrow \infty} \frac{1}{(1+r)^{n+1}} TD_{t+n}.$$

They assume that revenues (R) and expenditures (G) are integrated of order 1, i.e. $I(1)$, so that ΔR and ΔTG are stationary, and rearrange equation (7) to

$$(8) \quad TG_t = \alpha + R_t + \lim_{n \rightarrow \infty} \frac{1}{(1+r)^{n+1}} TD_{t+n} + \varepsilon_t.$$

Assuming that the second last term in (8) tends at the limit to zero leads to the test equation

$$(9) \quad R_t = \alpha + \beta TG_t + \varepsilon_t.$$

Given that TG and R are both difference-stationary, HAKKIO and RUSH (1991) define cointegration between these variables as a *necessary condition* for the present value budget constraint to hold. Furthermore, they show that $0 < \beta \leq 1$ is a necessary condition for the term in (8) to zero.

To test these hypotheses, HAKKIO and RUSH (1991) use U.S. quarterly data for the period from the second quarter of 1950 to the fourth quarter of 1988. They show that revenues and expenditures are co-integrated, but that the cointegration coefficient β is significantly lower than one. Furthermore, they find that the budgetary process exhibits a significant structural shift. When using the sample from 1964 to 1988, they show that the federal budget deficit violates the present value budget constraint. HAUG (1995) comes to the same conclusion when applying the same approach to quarterly data for the period from 1950 to 1990.⁷⁾

Using a similar methodology, QUINTOS (1995) introduces ‘strong’ and ‘weak’ conditions for intertemporal budget balance. Starting with regression equation (9), she defines that (i) ‘strong’ sustainability requires the co-integration between expenditures and revenues with the co-integrating vector $[1 \ -1]$, while ‘weak’ sustainability involves co-integration with $0 < \beta \leq 1$; and the budget deficit is not sustainable if $\beta \leq 0$.

To show the rational of these conditions, she reformulates equation (3a) in terms of first differences as

$$(10) \quad E_t \left[\lim_{n \rightarrow \infty} \frac{1}{(1+r)^{n+1}} \Delta TD_{t+n} \right] = 0.$$

Assuming a constant interest rate r , and under the condition that ΔTD is a stationary process, she derives the trajectory of the limit term in (10) depending on stochastic characteristics of ΔTD . If this is stationary, the evolution of the term at the limit is given by

$$(11) \quad E_t \left[\lim_{n \rightarrow \infty} e^{-\lambda n} \Delta TD_{t+n} \right] = 0,$$

where λ is a constant ($\lambda \geq 0$). If ΔTD is nonstationary, then this term can be described by

$$(12) \quad E_t \left[\lim_{n \rightarrow \infty} e^{-\lambda n} \sqrt{n} \Delta TD_{t+n} \right] = 0.$$

She shows that the stationarity of ΔTD_t is a *sufficient condition* for the term in (10) to go to zero. Furthermore, the term in (11) goes faster to zero than the one in (12) when revenues and expenditures are not cointegrated. She proposes (11) as the ‘strong’ and (12) as the ‘weak’ conditions for fiscal sustainability. As the term in (12) tends slower to zero, QUINTOS (1995)

7. See also KREMERS (1989) for a formal test.

suggests that the ‘strong’ condition for intertemporal budget balance is fulfilled, but that the government faces difficulties in managing its debt. When $0 < \beta < 1$, it is a *sufficient condition* for (12) to be valid.

QUINTOS (1995) starts with regression equation (9) in order to derive a testable hypothesis. Given that the residuals from the cointegrating regression are $I(0)$, if the revenues R and expenditures TG are cointegrated, she inserts (9) into the equation (1), and after rearranging she obtains the equation of undiscounted public debt as

$$(13) \quad \Delta TD_t = (1 - \beta) TG_t - \alpha - \varepsilon_t .$$

She shows, that if $0 < \beta < 1$ in (13), ΔTD is like TG nonstationary, regardless of whether R and TG are cointegrated. Accordingly, both conditions, (i) $\beta = 1$ and (ii) cointegration between R and TG , are together *necessary* and *sufficient* for (11) to hold.

In order to derive the weaker *necessary condition* for (12), after some rearranging, she rewrites (10) as

$$(14) \quad E_t \left[\lim_{n \rightarrow \infty} \frac{1}{(1+r)^{n+1}} \Delta TD_{t+n} \right] \\ = E_t \left[\lim_{n \rightarrow \infty} \left(\sum_{j=0}^n \left\{ \frac{[1+(1-\beta)]^{n-j}}{(1+r)^{n+1}} \right\} \Delta S_{t+j} + \left\{ \frac{[1+(1-\beta)]^n}{(1+r)^{n+1}} \right\} \Delta TD_{t-1} \right) \right],$$

where $S_t = (1 - \beta) G_t - \alpha - \varepsilon_t$. For (14) to work like (12), *the sufficient and necessary conditions* are together, (i) that $0 < \beta \leq 1$, and (ii), that ΔTD , while nonstationary, is only mildly explosive, given that ΔS is stationary.⁸⁾ Cointegration between revenues and expenditures with $0 < \beta \leq 1$ is only a *sufficient condition*. If $0 < \beta < 1$, then (12) is valid regardless of whether revenues and expenditures are cointegrated, since ΔTD is nonstationary following condition (14). If $\beta = 1$, then (11) is satisfied if the revenues and expenditures are cointegrated, while (12) is still valid if revenues and expenditures are not cointegrated.

Using U.S. quarterly data over the period from 1947 to 1992, QUINTOS (1995) finds that $0 < \beta < 1$ in the estimated model (9), and concludes that the U.S. budget deficit is ‘weakly’ sustainable for the entire sample.⁹⁾ Hence, by contrast to the previous studies, she proposes to use an alternative stability test to endogenously estimate the breaks in the data to the one proposed by HAUG (1992) and finds results which support the conclusions of HAKKIO and RUSH (1991). Revenues and expenditures are co-integrated with a cointegrating vector $[1 \ -1]$ in the first sub-period, while $0 < \beta \leq 1$, but revenues and expenditures are not co-integrated, and $0 < \beta < 1$ in the second sub-period.

8. See QUINTOS (1995, p. 411).

9. MARTIN (2000) performs this co-integration test by using an international data set.

The discussion of the previous empirical studies suggests that the analysis of sustainability produces differing results depending on the methods used. In this study we apply the test for cointegration between revenues and expenditures in order to test for sustainability of the Swiss federal budget deficit over the period from 1900 to 2002. In doing so, we follow the econometric methodology of QUINTOS (1995). We use the definition of strong sustainability when the revenues and expenditures are cointegrated with the cointegrating vector $[1 \ -1]$ and assume that the budget process is weakly sustainable for $0 < \beta \leq 1$. Furthermore, since the data covers World Wars and the Great Depression, which as exogenous shocks may nevertheless be relevant for fiscal sustainability, we adopt tests for co-integration which are robust to structural breaks. We apply the Chow-stability test to estimate structural breaks in the short-run relationship as proposed by STOCK and WATSON (1993). Hence, additionally, we use the modified cointegration test of GREGORY and HANSEN (1996) which allows for structural breaks in the parameters of the long-run relationship. Based on these results, we estimate the macroeconomic determinants of the federal budget deficit, following BARRO's (1979, 1986) tax smoothing model.

3 Data, Empirical Methodology, and Results

To analyse the Swiss federal budget policy we use annual fiscal data of the Swiss Federal Government for the period from 1900 to 2002. The data are taken from the Historical Statistics of Switzerland, and from several issues of the Statistical Yearbook of Switzerland and the Federal Budget. The data was obtained from the Federal Statistical Office and the Swiss National Bank, as well as other complementary sources. The series include federal non-interest expenditures, interest payments, military and non-military expenditures, revenues and federal debt, the real gross national product (GNP), the GNP deflator, the consumer price index (CPI), and the money growth aggregate M3. Since the federal budget deficit series which is reported in the official statistical sources does not account for interest payments, we made an appropriate adjustment of this series to make it consistent with the required theoretical set-up. The fiscal series considered in this analysis are defined ratios to GNP which are obtained by dividing their nominal values by nominal GNP.¹⁰⁾

3.1 Results of Stationarity Tests

We start the empirical analysis by examining the stationarity properties of the federal budget deficit, revenues and expenditures by using the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. We also perform the KWIATKOWSKI, PHILLIPS, SCHMIDT, and SHIN (KPSS) test which examines the null hypothesis of the stationarity of the time series. The results are in line with those from the unit root tests. We perform these different procedures

10. The sources of the data are given in the Appendix.

since their results are rather sensitive to the use of the long-run variance estimators if the time series are highly autocorrelated.¹¹⁾

Furthermore, PERRON (1989) points out that if a time series is trend-stationary but the test does not account for the time trend, the test statistics may be inadequately calculated as a result of the incorrect specification of the model. The visual examination of the data suggests the presence of a time trend; consequently we apply unit root and stationarity tests to the variables in levels and first differences. The results are given in *Table 1*.

Moreover, as PERRON (1989) argues, if a time series have a significant break in the trend function, the power of the standard unit root tests substantially decreases. To take this into account, we split the entire sample into two sub-samples, from 1900 to 1939 and from 1946 to 2002 by eliminating the observations during World War II, and perform unit root and stationarity tests for the pre- and post-World War II sub-periods. The results for these two sub-periods are also given in *Table 1*.

The sustainability of budget balance requires the stationarity of the primary budget deficit. For the entire sample, the results of the tests favour the stationarity of the deficit-GNP ratio: the coefficient of the autoregressive term in the ADF-regression is -0.233, with a t-statistic of -3.941. Hence, the result implies that the time series is trend-stationary. The findings are quite different for the sub-periods. Considering the pre-1939 sub-period, the tests suggest the non-stationarity of the deficit-GNP ratio: the coefficient of the autoregressive term is -0.140 with a t-statistic of -1.288. After 1946, the unit root hypothesis is rejected when we use the PP-test, but it cannot be rejected when we use the ADF- test. These results provide no evidence at all for the pre-World War II period and only weak evidence for sustainability after World War II. This is hardly compatible with the results showing sustainability for the entire period. However, the failure to reject the null hypotheses for the sub-periods might be due to the small numbers of observations and the low power of these tests.

The sustainability test based on the examination of the stationarity properties of the primary deficit is equivalent to a test for co-integration between revenues and expenditures under the condition that these series are of the same order of integration. To examine the stationarity properties of the revenue- and expenditure-ratios, we perform the same set of tests as conducted before. The results are also given in *Table 1*. They favour the existence of a unit root in the levels of the variables, but indicate stationarity for the first differences. The unit root and the stationarity test results for the pre- and post-World War II sub-periods are consistent with the findings related to the budget deficit-GNP ratio. The results for the post-World War II sub-period imply trend-stationarity of the federal revenue- and expenditure-GNP ratios. Thus, the next step is to test for a structural break related to World War II.

11. See MÜLLER (2005, p. 105).

We treat the year 1940 as the period that changes the trend function and apply the PERRON test to the variables defined in terms of GNP-ratios.¹²⁾ We estimate three models. Model (A) allows for one-time shift in the intercept of the trend function and is defined by

$$(15) \quad \Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_1 \Delta y_{t-1} + \dots + \beta_n \Delta y_{t-n} + \gamma D(TB_t) + \varepsilon_t,$$

where the dummy variable $D(TB)$ is one for $t = 1941$ and zero elsewhere.

Model (B) accounts for the change in the growth rate of the trend function and is defined by

$$(16) \quad \Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_1 \Delta y_{t-1} + \dots + \beta_n \Delta y_{t-n} + \delta DU_t + \varepsilon_t,$$

where the dummy variable $DU_t = 1$ for $t > 1940$ and zero elsewhere.

Finally, model (C) allows for a change in the intercept as well as the growth rate:

$$(17) \quad \Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_1 \Delta y_{t-1} + \dots + \beta_n \Delta y_{t-n} + \gamma D(TB_t) + \delta DU_t + \varepsilon_t,$$

Table 2: Unit Root Tests with a Structural Break in 1940						
Variables	Model A		Model B		Model C	
	k	$\hat{t}$	k	$\hat{t}$	k	$\hat{t}$
Public debt	4	-2.164	0	-2.063	0	-2.607
Revenues	3	-1.308	6	-2.050	3	-1.988
Expenditure	1	-1.415	1	-1.888	1	-1.989
Primary deficit	4	-3.882*	4	-4.045*	4	-3.950
Total deficit	4	-3.288	4	-3.406	4	-3.694
All variables are measured in relation to GNP. ‘***’, ‘*’ or ‘(*)’ show that the null hypothesis of no cointegration can be rejected at the 1, 5, or 10 percent level, respectively. – k is the number of lags.						

The results of the PERRON (1989) test for the federal budget deficit-GNP ratio series given in *Table 2* indicate that the break in the year 1940 does not produce any significant change in the series: the unit root hypothesis cannot be rejected at the 10 percent level of significance. The findings for the federal revenue- and expenditure-ratios show that after 1940 a significant change occurred in the levels and an increase in the slopes.¹³⁾

12. The Perron test is also performed for a break-point in the year 1946. The results are quite similar.

13. Critical values for the unit root test are from PERRON (1989, 1990) for $\lambda = 0.4$, which is the ratio of the number of observations in the pre-World War II sub-period to the total number of observations in the sample.

The results for the whole period and for the two sub-periods are given in *Table 3*.¹⁴⁾ The ADF-test gives a t-statistic of -3.120, which is significant at the 10 percent level. This indicates that the federal revenue- and expenditure-GNP ratios are co-integrated when we use the full sample. The findings are consistent with the results obtained from unit root tests which also point towards the stationarity of fiscal balance-GNP ratio in the whole sample. However, the Jarque-Bera statistics indicate that the residuals are not normally distributed. Excluding the years that may be viewed as outliers we check whether the estimated co-integrating vector is consistent with the theoretical prediction.¹⁵⁾ In this case, the co-integrating vector is [1 -0.999]. This suggests that the federal budget deficit is sustainable over the entire period.

The results are again different if we look at the two sub-periods. In the pre-World War II sub-period, the federal revenue- and expenditure-GNP ratios are not co-integrated; the t-statistic is only -2.010. Similar results are obtained from regression of expenditure on the revenue-GNP ratio: a t-statistic of -1.403 is not significant at any conventional level which lends further support to the findings of the unit root and stationarity tests. Moreover, the federal budget seems not to be balanced in the post-World War II sub-period. Though the ADF-test rejects the null hypothesis of non co-integration with a t-statistic of -3.782 at the 5 percent level, the estimated co-integrating vector is [1 -0.726]. This provides evidence for weak sustainability of the budget deficit in the post-World War II sub-period.

3.3 Results of Tests for Structural Breaks in the Long-Run Relationship

To accommodate possible shifts in the parameters of the co-integrating vector we follow GREGORY and HANSEN (1996) and use the test for stability of the estimated coefficients by allowing for a one-time structural change in the deficit generating process.

In order to check the structural breaks, we perform Chow-tests for the null hypothesis of a constant cointegrating relation against the alternative of different cointegrating vectors in the pre-and post-World War II sub-periods. We apply this test to the dynamic ordinary least-squares regression using two lags and assuming an AR(4) process.¹⁶⁾ The results are shown in *Figure 3*.¹⁷⁾ They show that the null hypothesis of no break can be rejected at all conventional significance levels at several points over World War II sub-period.

14. Critical values for the ADF-test are taken from MACKINNON (1991) and for the Durbin-Watson statistic from ENGLE and GRANGER (1987). In order to provide the robustness analysis of the estimated model (9), we also performed reversed regressions. The results are given in the second part of *Table 5*.

15. We exclude the years 1919 to 1921 as well as 1939 to 1946 from the sample.

16. See for this STOCK and WATSON (1993). Using a similar test, HAKKIO and RUSH (1991) and HAUG (1995) show that the structural break-points have a significant effect on the sustainability of the U.S. federal budget deficit. QUINTOS (1995) arrives at the same conclusion by applying the modified Wald-test.

17. Following the suggestion of ANDREWS (1993) we perform the tests only for the trimmed sample by eliminating the initial and the final 15 percent.

Based on this evidence, in the following analysis we treat World War II as a shock which significantly changes the parameters of the co-integrating regression. To examine the question of whether this break-point has a significant effect on the intertemporal budget balance, we perform the GREGORY and HANSEN (1996) modified co-integration test. This evidence concerns the properties of the cointegrating residuals which are different for the pre- and post-World War II sub-periods.

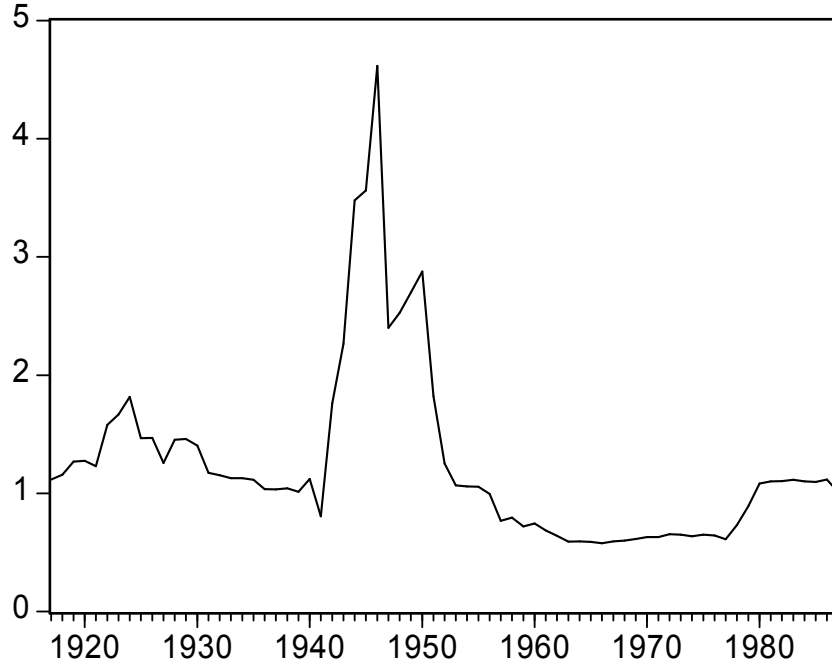


Figure 3: Values of the chi-squared test for parameter stability in the cointegrating vector

GREGORY and HANSEN (1996) offer three models that allow for correcting the co-integrating relationships in the presence of structural break-points. Assuming a break-point in the year 1940, the first model (A) which accounts for the level shift in the co-integrating relationships is given by

$$(18) \quad R_t = \alpha + \beta_1 TG_t + \beta_2 DU_t + \varepsilon_t,$$

where the dummy variable $DU_t = 1$ for $t > 1940$ and zero elsewhere.

The second model (B) includes the time trend and accounts for the change in the slope

$$(19) \quad R_t = \alpha + \beta_1 TG_t + \beta_2 DU_t + \beta_3 Time + \varepsilon_t,$$

where additionally Time is included which denotes a time-trend.

Finally, a third model (C) allows for a regime shift in the co-integrating relationships

$$(20) \quad R_t = \alpha + \beta_1 TG_t + \beta_2 DU_t + \beta_3 (DU_t \cdot TG_t) + \varepsilon_t,$$

where $(DU \cdot TG)$ represents a regime shift in the deficit generating process. In a second step, we apply the ADF-test to the residuals from each of the estimated co-integrating models (18) to (20) to assess our null hypothesis. The critical values are from GREGORY and HANSEN (1996).

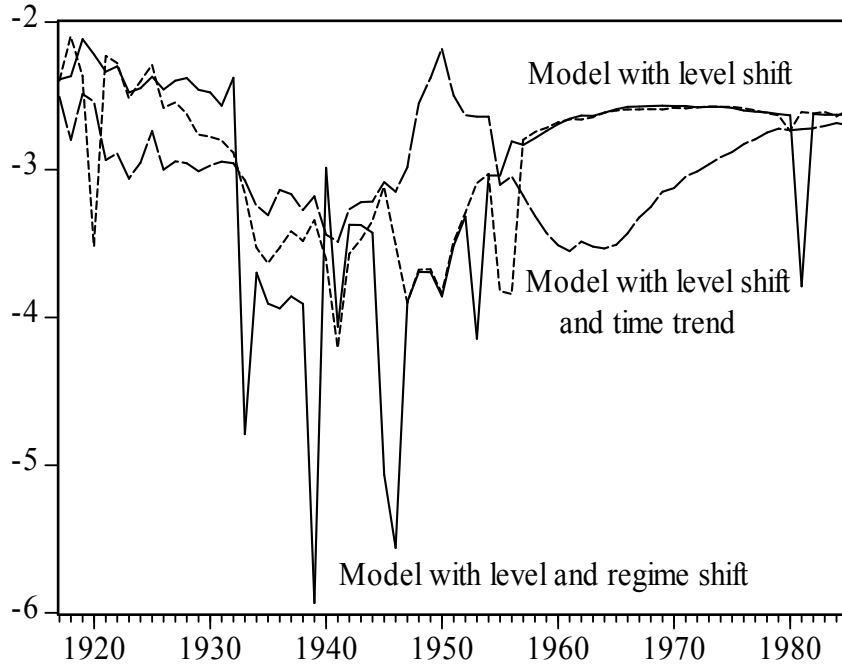


Figure 4: Test statistics if the ADF-test for cointegration between federal revenue- and expenditures-GNP ratios

Figure 4 depicts the $ADF(\tau)$ -statistics of the residuals from each of three estimated co-integrating models (20) to (22) by treating each year in the interval $[(0.15T), (0.85T)]$ as a break-point. The figure illustrates that the significant ADF-values are estimated for several break-points during the pre-World War II sub-period: these findings confirm the assumption of non-sustainability of budget deficit over this time period. Hence, this figure provides evidences for several significant break points in the post-World War II sub-period.

3.4 Results of Johansen Cointegration Test

In addition to the ADF-test, we also use the JOHANSEN (1988) multivariate cointegration test in order to determine the number of co-integrating vectors in the system. We perform the trace test and as well as the maximum eigenvalue test, and we assume that there is a constant in the error-correction-term. The lag length of the VAR is selected by using the Schwarz criterion. Critical values are taken from OSTERWALD-LENUM (1992).

Table 4 shows the results for the entire sample and for the two sub-periods from 1900 to 1939 and from 1946 to 2002. These results support the hypothesis of co-integration between reve-

nues and expenditures as shares of GNP, with a co-integrating vector of [1 -1.045] for the entire sample; these findings are economically reasonable.

Table 4: Results of the Johansen Cointegration Test					
Eigenvalue	Null hypothesis	Lags	Trace statistic	Maximum eigenvalue statistic	Normalised cointegration vector
1900 – 2002					
0.214	$r = 0$	4	27.91**	23.70**	[1.0 0.005 -1.045]
0.042	$r = 1$	4	4.21	4.21	
1900 – 1939					
0.215	$r = 0$	1	11.96	9.21	[1.0 -0.000 -1.070]
0.069	$r = 1$	1	2.74	2.74	
1946 – 2002					
0.497	$r = 0$	4	40.74**	39.20**	[1.0 -0.020 -0.783]
0.026	$r = 1$	4	1.54	1.54	
‘***’, ‘**’ or ‘(*)’ show that the null hypothesis of no cointegration can be rejected at the 0.1, 1, 5, or 10 percent level, respectively.					

The evidence for the sub-periods is also in line with the previous results. The shares of revenues and expenditures of GNP-ratios are co-integrated with a cointegrating a vector of [1 -0.783] for the post-World War II sub-period. The χ^2 test statistics of the hypothesis that the co-integrating vector is [1 -1] is 0.22 with a p-value of 0.63. It is also quite close to the estimated coefficient $\hat{\beta} = 0.726$ in the static regression of the ENGLE and GRANGER (1987) test.

Taking all results together, the federal budget deficit is consistent with the intertemporal budget constraint over the entire period where the share of the primary deficit of GNP is stationary, and, hence, federal revenues and expenditures are cointegrated with a cointegrating vector close to [1 -1]. When using the two sub-samples, the results show that the intertemporal budget constraint is violated for the pre-World War II period, while the weak sustainability condition may hold in the post-World War II period.

4 Determinants of the Federal Budget Deficit

In this section we focus on the main determinants of the federal budget deficit. This question translates into testing whether the federal budget deficit can be explained by macroeconomic factors such as expected inflation, the cyclical position of the economy which influences tax revenues and temporary changes in the structure of federal expenditures. Following the theoretical approach of the tax smoothing model of BARRO (1979, 1986), we analyze whether the

above-mentioned factors which explain the federal budget deficit in Switzerland in the post-war period differ significantly from those during the World Wars.

The tax smoothing approach models the budget deficit as a linear function of the variations of the expected rate of inflation, the temporary fluctuations of the government expenditures during wartime,¹⁸⁾ cyclical fluctuations of the output during the economic booms and the recessions.¹⁹⁾ We extend this model to the following system of equations

$$(21) \quad D_t = \alpha + \beta_1 \pi_t^e + \beta_2 TD_t + \beta_3 RGNP_t + \beta_4 RMG_t + \beta_5 D_{t-1} + \varepsilon_t,$$

$$(22) \quad \pi_t = \gamma_0 + \gamma_1 \pi_{t-1} + \gamma_2 \pi_{t-2} + \gamma_3 m3_{r,t-1} + \gamma_4 gnp_{r,t-1} + \gamma_5 gnp_{r,t-1} + \eta_t.$$

In this model D is the nominal federal budget deficit divided by the nominal GNP, π^e represents expected inflation TD is the nominal federal debt divided by the nominal GNP, $RGNP$ is a measure of temporary output fluctuations, i.e. the output gap, RMG a measure of the temporary fluctuations of federal military expenditures, of its deviation from its long-run equilibrium path, π_t the annual inflation rate calculated on the basis of the consumer price index,²⁰⁾ $m3_r$ is the growth rate of real money $M3$, and gnp_r the growth rate of real GNP.

Theory predicts that cyclical fluctuations in output which are caused by an economic boom and/or a recession have a significant impact on the budget deficit: the deficit increases when the output gap is negative, i.e., when it lies below its ‘normal’ level.²¹⁾ The Swiss economy did experience cyclical fluctuations in the considered post-war period: the negative output gap was several times below the 2 percent level.²²⁾ Following the previous literature, we examine the hypothesis by testing the effect of the output gap which is defined as a difference between the real GNP and the trend of the real GNP.²³⁾ The coefficient of the output gap variable in model (22) is suggested to be close to one.

As is shown in Figure 1, a significant determinant of the budget deficit is a temporary increase in public expenditures during wartime. As shown by BARRO (1979, 1989) and SAHAKASUL (1986), such fluctuations are caused by an increase in federal military expenditures during wartime. Accordingly, we test this hypothesis by examining the effect of temporary fluctuations in military expenditures on the budget deficit.²⁴⁾ The theory predicts that the es-

18. See, e.g., BARRO (1979, 1986), SAHASAKUL (1986) and BOHN (1998, 2004).

19. See BARRO (1979) and BOHN (1998, 2004).

20. The change in the consumer price index is stationary at levels. The computed ADF-test statistic is -5.856 (with 1 lag).

21. See BARRO (1979, 1986).

22. See BUNDESRAT (2000, p.4673).

23. To calculate the trend in real GNP we use the HP-filter and set the smoothness parameter λ equal to 100.

24. Since the federal military expenditures are non-stationary in the second sub-period, we calculate their fluctuations as a difference between the real military expenditures and the estimated trend of real military expenditures which is computed by using the HP-filter (all variables are used in the natural logarithms).

estimated coefficient may be close to one if an increase in expenditures above the ‘normal’ level does not cause either a significant change in civil expenditures or an unusual tax increase.²⁵⁾

The intertemporal budget constraint links the budget deficit and the public debt. BOHN (1998, 2004) defines the budget deficit as sustainable if it responds negatively to an increase in public debt. In order to improve the intertemporal budget balance, the government should compensate an increase in public debt by reducing the non-interest expenditures and/or by increasing taxes.

BARRO (1979, 1986) assumes that the budget deficit is also a linear function of the expected inflation rate. To test this hypothesis, we follow the methodology of JORDAN, KUGLER, LENZ, and SAVIOZ (2002) and, using 30 observations, we calculate the expected inflation by out-of-sample forecasts with rolling estimation of the equation (23).²⁶⁾ The predicted coefficient on the expected inflation rate in the budget deficit equation is suggested to be close to one.

Using OLS, the results for the deficit equation (21) over the entire sample from 1930 to 2002 are as follows:²⁷⁾

$$(23) \quad D_t = \begin{matrix} 0.006 & + & 0.113 & \pi_t^e & + & 0.028 & TD_t & - & 0.014 & RGNP_t & + & 0.038 & RMG_t \\ (0.14) & & (0.56) & & & (1.36) & & & (-0.25) & & & (3.20) \end{matrix} \\ + 0.589 D_{t-1} + \hat{\varepsilon}_t, \\ (3.86) \\ SER = 0.009, \quad R^2 = 0.852, \quad D.-W. = 1.496, \quad J.-B. = 0.527.$$

The results for the sub-period from 1946 to 2002 are given by

$$(24) \quad D_t = \begin{matrix} -0.001 & + & 0.661 & \pi_t^e & + & 0.020 & TD_t & - & 0.051 & RGNP_t & + & 0.015 & RMG_t \\ (-0.66) & & (2.55) & & & (1.70) & & & (-1.58) & & & (1.86) \end{matrix} \\ + 0.335 D_{t-1} + \hat{\varepsilon}_t, \\ (1.96) \\ SER = 0.007, \quad R^2 = 0.380, \quad D.-W. = 1.653, \quad J.-B. = 0.197.$$

The coefficient of total federal debt is in both equations positive, i.e. it has the ‘wrong’ sign. Moreover, for the period after World War II it is even significant at the 10 percent level. This causes doubts on the sustainability of deferral fiscal policy. The output gap has the expected negative impact on the public deficit, but its impact is neither for the entire sample nor for the

25. See BARRO (1979, 1989).

26. See JORDAN, KUGLER, LENZ, and SAVIOZ (2002) for Swiss inflation forecasts by using a VAR-Models. See also BALTENSPERGER, JORDAN and SAVIOZ (2001) who show that M3 is a relevant indicator of future inflation in Switzerland. See for this also DUEKER and FISCHER (1996).

27. The numbers in parentheses are the t-statistics of the estimated coefficient, SER is the standard error of the regression, D.-W. is the Durbin-Watson statistics, and J.-B. the Jarque-Bera statistics. We use Newey-West estimates for the standard errors to correct for autocorrelation and heteroscedasticity. – The available data allows us to compute the expected inflation only for the period from 1930 to 2002.

period after World War II significant. Contrary to this, military expenditure do have a significant impact, at the 1 percent level for the entire period and still at the 10 percent level for the second sub-period. However, its estimated coefficient is far away from the theoretically expected value of one, indicating that civilian expenditure have been reduced and/or taxes increased to finance part of the additional military expenditure during the wars. Finally, the expected inflation rate is insignificant for the whole period, but significant for the second one, with a coefficient which is considerably below but statistically not different from one.

5 Concluding Remarks

This study asks whether fiscal policy of the Swiss federation is sustainable. We consider the period from 1900 to 2000, but – allowing for a structural break in relation to World War II – also for the two sub-periods from 1900 to 1939 and from 1946 to 2002. Using annual data, we perform several unit root and stationarity tests as well as tests for co-integration between the revenue- and expenditure-GNP ratios. All tests provide more or less the same picture which is, however, in itself contradictory. Considering the whole period, the estimated results suggest that the federal fiscal policy is sustainable, the budget deficit is consistent with the intertemporal budget constraint. Revenue- and expenditure-GNP ratios are, e.g., cointegrated with a cointegrating vector close to $[1 \ -1]$. If we consider the two sub-periods separately, we get, however, quite different results: Swiss fiscal policy does not seem to be sustainable in either of the two periods; there is at best evidence for weak sustainability in the period after World War II.

The question is how to interpret this puzzle. It can hardly be caused by the structural break in relation to World War II, as in this case the opposite result should occur: sustainability for the two sub-periods but no evidence for sustainability over the whole period. An alternative, but also hardly satisfactory explanation might be that the power of the unit root and cointegration tests is too low to reject the null hypotheses in the sub-periods but it might be sufficient to reject them if we consider the whole period.

If we look at the more recent development as shown in *Figures 1* and *2*, another explanation might be more convincing: even in historical perspective, the large deficits in the federal budget outside war times arose in the last thirty and especially in the last fifteen years. This results in a more or less steady increase of the federal debt since 1975. Thus, even if fiscal policy was sustainable up to the mid seventies of the last century, it might be no longer sustainable in the most recent past. If we consider the whole period compared with the war time deficits, these more recent deficits do not seem to be very large, but considering the situation in peace times they are. This was also the conviction of the Swiss citizens when they accepted the introduction of a debt brake at the federal level in 2001. Such debt breaks have been proved to be quite effective in some Swiss cantons like St. Gall and Fribourg, where they

were introduced several decades ago,²⁸⁾ and the hope is that this institution will bring back federal fiscal policy on a sustainable path.

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28. See FELD and KIRCHGÄSSNER (2004).

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Appendix: Data and Sources

- Federal revenues
 - Federal expenditures
 - Federal public debt
- Sources: Historical Statistics of Switzerland, several issues of the Statistical Yearbook of Switzerland, and Swiss Federal Finance Administration
- Real Gross National Product (GNP)
 - GNP deflator
- Sources: Swiss Federal Statistical Office
- Consumer price index
- Sources: Federal Reserve Bank of St. Louis, FELIX ANDRIST
- Real monetary aggregate M3
- Sources: Historical Statistics of Switzerland, and Swiss National Bank

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