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DEFICITS AND MONEY GROWTH: EMPIRICAL EVIDENCE FOR SWITZERLAND

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Abstract

This paper examines the relationship between fiscal policy as measured by different deficit (or surplus) variables and the growth rate of the monetary base and the money supply M1 for Switzerland. Regression estimates using quarterly data over the period of flexible exchange rates (from 1973.2 to 1994.1) suggest that changes in the money supply M1 are not associated with changes in deficits. With monetary base growth as dependent variable indications of a significant deficit money growth linkage can only be found for the period from 1973.2 to 1979.4. While federal and total deficit measures as well as their structural components are associated with a faster growth rate of the monetary base, the relationship with a cyclical component of the federal deficit is negative for this period. It is argued that these results are inconclusive with respect to the debate on the political (in)dependence of the central bank, even if identification problems are neglected.

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Deficits and Money Growth: Empirical Evidence for Switzerland

1. Introduction

Direct political influence on monetary policy is analyzed in the framework of elections, parties and administrations. Indirect political influence is investigated by testing for effects of fiscal policy on monetary policy. (Laney/Willett 1983 54; Alesina/Sachs 1988 67 FN 6; Lang/Welzel 1992 73) The impact of fiscal policy on monetary policy is frequently studied in the context of a budget deficit (or surplus) money supply relationship. The basic argument is that fiscal policy controls macroeconomic variables, for instance the deficit, that influence monetary policy. The way the central bank reacts to these variables is interpreted as evidence on the (in)dependence debate.

This paper investigates the budget deficit (or surplus) money supply relationship for Switzerland. The purpose is twofold: (1) to test for the significance of fiscal variables using various deficit measures, and (2) to test for the structural stability of these coefficient estimates for the period of flexible exchange rates.

Estimation results using quarterly data for the time period from 1973.2 to 1994.1 differ for the two dependent variables investigated. With the growth rate of the money supply M1 as dependent variable deficits have virtually no impact on monetary policy. With the monetary base as dependent variable a significant response to the federal and total deficits as well as to their cyclical and structural components can be found for the period from 1973.2 to 1979.4. Following the conventional interpretation the positive sign on the structural component of the federal and total deficit implies accomodating behavior and is inconsistent with the hypothesis that the Swiss monetary authorities act independently of the fiscal authorities. It is argued that the cyclical component of the deficit may also yield evidence on the (in)dependence debate. The negative response of monetary base growth to the cyclical component of the federal deficit for the period before 1980 is rather consistent with political independence of the central bank.

However, these interpretations cannot directly be inferred. It can only be argued that the results are consistent with these interpretations. They could be consistent with other arguments, too. Because of the long and deep recession in the seventies the positive sign on the structural component of the federal and total deficit might indicate an offsetting response to weak growth

rates of GDP rather than an accomodation of the deficit. And depending on the assumed cyclical state of the economy and the assumed length of the Friedman lag the negative sign on the coefficient of the cyclical deficit could also be consistent with political dependence. Therefore, it is argued that these results are inconclusive with respect to the debate on the political (in)dependence of the central bank.
The paper is organized as follows. Section 2 discusses the theoretical background of the linkage between fiscal and monetary policy. Section 3 reviews existing work on this relationship for Switzerland. Section 4 develops the money growth equation estimated in this paper. Section 5 contains some comments on the data. Section 6 presents the estimation results. Section 7 offers some concluding remarks.

2. Budget Deficits and Money Growth

A central bank is not concerned with deficits per se, but with deficits as they affect macroeconomic variables that the central bank is trying to control. Since the central bank is the authority ultimately responsible for price stability, the potential impacts of deficits on inflation are of special interest.[1] Two possible links are usually discussed in the literature:[2]
Keynesians argue that budget deficits are inflationary because they stimulate aggregate demand. This theory suggests a linkage between the full-employment deficit[3] and inflation, but not between the actual deficit and inflation. Actual deficits can be high either because the full-employment deficit is high or because the economy is in a recession. In a recession the rate of capacity utilization is low so that deficit spending will affect quantities rather than prices. The inflation rate will not be high, even though the deficit will be high. The higher the rate of capacity utilization the more likely will increased deficit spending feed inflation.

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1 For a more general discussion of the macroeconomic consequences of deficits with an explicit application to Switzerland see Buomberger/Schwab 1993 and Schwab 1994a 11-16. For international evidence on the macroeconomic effects of budget deficits see Karras 1994.

2 Following Parkin 1987 these might be called mechanical links and 'behavioral' links. "By mechanical links I mean the links between the deficit and the price level with unchanged settings of policy instruments. By 'behavioral' links I mean those links that arise as a result of actions taken by those who set policy instruments." Parkin 1987 317.

3 The full-employment or structural deficit measures the deficit that would prevail at some trend level of potential output. It removes the effects of the business cycle from the measured deficit. Perry 1987 762.

Monetarists emphasize the relationship between deficits, money growth, and inflation. The central question is whether government deficits cause money growth. A government can finance its budget deficit by selling bonds to the central bank (printing money), or by selling bonds to the private sector (borrowing from the public).[4] Formally independent central banks are not required to purchase bonds from the government, so that a direct monetization[5] can be excluded. Borrowing from the public *can* lead to excessive money growth and cause inflation. This argument is generally based on the assumptions that (1) deficits tend to drive up nominal and real interest rates and that (2) the central bank takes efforts to smooth interest rates. (Hamburger/Zwick 1981 147; Levy 1981 351; Joines 1990 414) While the assumption that central banks try to avoid substantial interest rate escalations and variability is plausible,[6] the question whether deficits lead to higher interest rates is complex and remains controversial.

A positive relationship between deficits and interest rates seems a trivial application of supply and demand. (Dwyer 1985 656) As the deficit rises, the supply of government bonds increases and, ceteris paribus, the interest rate rises. However, budget deficits need not always place upward pressure on interest rates.

According to the capital-inflow hypothesis rising interest rates caused by budget deficits attract foreign capital and thereby attenuate any relationship between deficits and interest rates. (Dwyer 1985 674) This hypothesis may be especially plausible for small open economies. In the limiting case of an infinitely elastic demand for government securities a government deficit does not affect the interest rate. However, the capital inflow may ultimately lead to interest rate increases if the government seeks to maintain the exchange rate by selling domestic currency to meet foreign demand. This inflationary policy encourages a subsequent rise in the interest rate.

Ricardian equivalence[7] is another argument which weakens the link between budget deficits and interest rates. If individuals are indifferent between paying taxes in the present and paying taxes in the future the present generation will increase saving to cover

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[4] Another possibility of financing budget deficits is to run down foreign exchange reserves.

[5] The government sells bonds to the central bank rather than to the private sector, thereby increasing the money supply.

[6] However, for a criticism of this proposition see Niskanen 1978 597.
According to Cagan (1985 215) the Federal Reserve for instance conducted monetary policy with an interest-rate target in one form or another, except for a brief period from late 1979 to mid-1982.

[7] A modern version of this theorem is presented by Barro 1974.

the liability of a bond financed deficit.[8] If the increase in saving is approximately the same amount as the rise in the deficit, then aggregate demand does not change and interest rates are not affected.[9]

Interest rate effects also depend on the cyclical state of the economy. When the economy is contracting, the private sector demand for funds is falling, and deficit spending should cause negligible financial market pressure. Upward pressure on interest rates is more likely when the economy is near full employment and when the private demand for funds is high.

Whether deficits lead to higher interest rates is an empirical question.[10] Evidence for some countries with high budget deficits suggests the existence of a positive relationship. (Münster 1994; Uhlig 1994) However, there is no evidence that government deficits are associated with higher interest rates in Switzerland.[11]

Interest rate effects and aggregate demand effects are not independent. Rising interest rates will tend to induce crowding out of private investments. This reduces aggregate demand and thus lowers the upward pressure on prices. Hence, in the short run crowding out effects will operate in the other direction and thus help to dampen these price effects. But in the long run crowding out has negative effects on potential production and retards growth. (see e. g. Karras 1994 191)

With a formally independent central bank any relationship between deficits, money growth and inflation is a result of decisions made by the monetary authority. It has the discretionary power to accomodate, not to accomodate, or even to offset the fiscal disturbance. In deciding whether to accomodate a deficit or not the central bank may face a dilemma. If it decides not to accomodate fiscal policy, interest rates *may* rise and thus crowd out private investment and consumption. If it decides to accomodate fiscal policy, it will buy government bonds to keep interest rates from rising, and a crowding out of private expenditures can be prevented (at least in the short run). By doing

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[8] Therefore, the effects of budget deficits and taxation are the same, because both result in a reduction in consumption in the present generation.

[9] For a criticism of the Ricardian equivalence theorem see for instance Buchanan 1976; Jordan 1993 93-100.

[10] According to Dwyer (1985 656) the most noticeable omission in this area of research is any review of evidence concerning the relationship between deficits and interest rates.

[11] However, Buomberger/Schwab (1993 11) and Schwab (1994a 15) find a significant positive relationship between their measure of the structural component of the total deficit (i. e. the sum of federal, cantonal, and communal deficits) and the government bond yield.

this, however, the central bank is in effect allowing the government to finance itself by printing money - the deficit is monetized. And if money growth is excessive it will lead to inflation.

The way the central bank 'solves' this dilemma is considered as being evidence on the (in)dependence debate. Monetization of the deficit may eventually increase aggregate demand. This will raise the real interest rate and induce crowding out. Monetizing the deficit ultimately fails to prevent crowding out. But it leads to inflation. A politically independent central bank that tries to control inflation should therefore not monetize the budget deficit. (Demopoulos/Katsimbris/Miller 1987 1023) It may even attempt to neutralize (offset) the fiscal expansion by tightening monetary policy. If a central bank is observed to monetize the deficit, it is concluded that it is yielding to political pressure to expand the money supply.[12] Notice that it is the preoccupation with the stabilization of interest rates (i. e. the targeting of interest rates) that pressures the central bank into monetizing the deficit.

Political pressure on monetary policy may arise for various reasons. (see e. g. Tietmeyer 1993; Thieme 1993 174) The effectiveness of fiscal policy measures often depends on the behavior of the monetary authority. Fiscal authorities will therefore pressure the central bank to 'coordinate' monetary policy with their own fiscal policy actions. Fiscal authorities can pressure the central bank to keep interest rates low in order to reduce the burden of interest payments (easy money policy). Rising interest rates caused for instance by deficit financing, may attract foreign capital and lead to an appreciation of the exchange rates. This may induce political pressure to stabilize exchange rates. Or the central bank may simply be pressured to increase the money supply in order to raise revenue through its right to create money (seignorage).

Whether a formally independent central bank cedes to these political pressures is an empirical question. It is frequently argued that central banks owe their appearance of independence to the tacit cooperation with the goals of elected fiscal authorities. (Kane 1980)

When testing the hypothesis whether a central bank monetizes the deficit the manner in which a deficit is generated may matter. Deficits can arise either through the automatic revenue losses and expenditure increases that occur when the economy is

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12 If central banks are targeting interest rates, they are "pressured into monetizing deficits to defend the interest rate targets; the resulting inflation is the 'price' they pay." Demopoulos/Katsimbris/Miller 1987 1025.

in a recession (cyclical deficits), or through legislated changes in spending and taxation (structural deficits). There are at least two reasons why this distinction between cyclical and structural deficits is important. (Grier/Neiman 1987 202; see also Laney/Willett 1983 57)

First, inflationary effects of deficits - either as a result of the increase in aggregate demand or in the context of the money-growth relationship (accomodation by the central bank) - depend on the cyclical state of the economy. Since cyclical deficits occur when the economy is in a recession, they are unlikely to cause significant upward pressure on interest rates and inflation. However, structural deficits at or near full employment may generate financial market pressures. If a central bank is only concerned with stabilizing interest rates, it should respond to the structural deficit rather than to the cyclical deficit.

Second, the central bank may pursue a countercyclical monetary policy designed to smooth out the business cycle. If this is its only concern, then the cyclical deficit will be a significant determinant of monetary policy because of its high correlation with the business cycle. The structural deficit should have little or no impact in this case.

A central bank may respond to both financial market pressures and the business cycle. "But unless the response to interest rate pressures caused by structural deficits is somehow the same as the response to the business cycle as proxied by the cyclical deficit, it is not correct simply to use the measured deficit as an independent variable in a regression explaining money growth." (Grier/Neiman 1987 202) In any empirical investigation of the relationship between deficits and money growth in the framework of political dependence the actually measured deficit should be divided up into cyclical and structural components. This reduces the danger of spurious correlation which might result from corresponding cyclical variations in both monetary and fiscal policy. (Hamburger/Zwick 1981 146 FN 5; Laney/Willett 1983 57; Cagan 1985 215).

However, the actual deficit would seem to be the correct measure if seignorage is the explanation for the deficit-money link. (Grier/Neiman 1987 202) The (politically dependent) central bank deliberately increases money stock as a means of raising government revenue. (Klein/Neumann 1990).

There are regular attempts to increase the amount of central bank profits to be transferred to the fiscal authorities (confederacy and cantons) so that the seignorage argument cannot be

completely excluded for the Swiss National Bank (SNB).[13] Hence, the relationship between the actual deficit and money growth is also investigated.
Still, the theoretical case for the seignorage argument may be rather weak in the case of the SNB. Therefore, the actually measured deficit is divided up into cyclical and structural components to find out whether any response of the central bank to the deficit may be due to the business cycle argument or to the market pressure argument.
Usually it is argued that an accomodating response of monetary policy to the structural component of the deficit is consistent with political dependence of the central bank, while an offsetting response to the structural deficit suggests political independence.
However, it could be argued that the coefficient on the cyclical component of the deficit also yields information on the political (in)dependence debate. Generally, the SNB is not held responsible for the trend in long term interest rates (since these are rather determined on the international level). However, the SNB is regularly pressured to take an (more) active role in the business cycle, especially when the economy is in a recession.
Since the cyclical deficit is a measure of the business cycle, the reaction to the cyclical component of the deficit represents the central bank's response to the business cycle. A rise in the cyclical deficit (defined as expenditures minus revenues, so that the deficit is a positive number) means that the economy is moving into a recession. Hence, a positive sign on the cyclical deficit could suggest countercyclical monetary policy at first glance. However, it is well known that monetary policy works with long (and eventually also variable) lags. Accepting the proposition that the Friedman lag is two years for Switzerland and the business cycle is four years on average, this monetary policy is likely to work procyclically. Since the central bank is aware of this, it should not accomodate cyclical deficits. If it is, then it can be argued that it is yielding to political pressure. Hence, a positive sign on the cyclical component of the deficit suggests accomodating behavior and political dependence. A negative coefficient would be rather consistent with political independence.
Of course, it can only be argued that an accomodating behavior of the central bank to the cyclical deficit *is consistent* with

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13 Before 1990 the SNB delivered a rather symbolic amount to the government: 5.016 Mio. Swiss francs annually between 1971 and 1980, 5.093 Mio. Swiss francs annually between 1981 and 1990. Since 1991 an additional 600 Mio. Swiss francs are handed over to the confederacy and the cantons each year. Even this amount is rather modest.

political dependence. But it could be consistent with other arguments as well. It could for instance be part of the central bank's own stabilization plan and have nothing to do with political dependence.

3. Previous Studies on the Impact of Fiscal Policy Variables on Swiss Monetary Policy

Evidence on the effects of fiscal policy on monetary policy is most frequently reported in the context of reaction function studies. Two types of reaction function approaches can be distinguished in the literature. (see e. g. Landon/Reid 1990 382) Most studies estimate a central bank reaction function within a *single equation framework*. Usually the change in the money supply is regressed against a set of explanatory variables that includes some measure of the government's budget position. (Examples are cited in Landon/Reid 1990 and Dwyer 1985.) In some studies the central bank's reaction function is imbedded within a *system of equations* describing the macroeconomy, and the reduced form reaction function is derived from some optimizing model. (Examples are Levy 1981; Turnovsky/Wohar 1987; Landon/Reid 1990).

As an alternative[14] to reaction function studies some authors employ autoregressive model specifications. The growth rate of the money supply is regressed on several lagged dependent variables, a constant, and the variable(s) measuring fiscal policy. (An example is Grier/Neiman 1987).

Numerous empirical studies attempt to determine whether federal budget deficits lead to higher money growth in the U.S. The quantitative evidence remains mixed, however; a consensus does not exist. "In fact, recent empirical studies have found this connection to be either positive and significant or zero, and stable or unstable over time." (Grier/Neiman 1987 201; see also Burdekin/Wohar 1990 534; Joines 1990 413; Karras 1994 190) For other central banks a smaller number of studies are available, but here too, results are mixed. (Demopoulos/Katsimbris/Miller 1987 1027)[15] The deficit money growth relationship estimated is sensitive to the specification of the regression equation, the

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[14] As a third category Landon/Reid (1990 382) list causality studies examining the linkages between money growth and a variety of macro variables. Examples are Dwyer 1982 and McMillin 1986.

[15] More recent empirical evidence on Germany is provided by Lang/Welzel 1992. Using annual values for the period from 1962 to 1989 they find some accomodating behavior for the German Bundesbank.

periodicity of the data[16], and the time period considered[17]. Studies differ from one another considerably in the type of equations, monetary aggregates (as dependent variables), deficit measures, and other control variables used. They also vary by choice of data periodicity and sample period. Therefore, it is not surprising that results also vary. (Grier/Neiman 1987 204) However, Dwyer (1985 677) sees the underlying problem with these conflicting estimates in the fact that there is little underlying theory to impose constraints on the estimates.

There is some quantitative evidence on the relationship between fiscal and monetary policy for Switzerland, too. Table 1 offers a summary of these papers.

Giannaris/Kolluri (1985) analyze the effects of budget deficits on money supply growth and inflation for ten industrialized countries including Switzerland over the period 1950-81. They specify and estimate a two-equation econometric model consisting of the money supply growth and inflation equations. The growth rate of the money stock M1 is assumed to depend on the growth rate of the expected money supply as predicted by lagged dependent variables and the lagged nominal budget deficit (national income account basis) as a percentage of nominal GNP. Estimation results using annual data reveal that the budget deficit is not a significant determinant of the money supply growth in Switzerland (the coefficient reported is 0.001134 with a t-value of 1.00). Alternative model specifications and the use of other fiscal variables (nominal government expenditures divided by the GNP deflator multiplied by trend real GNP lagged one year) produce similar results.

Also of interest in the present context are the results of their inflation equations. Assuming that inflation is a function of the current and the lagged money supply growth rates and the lagged budget deficit a significant (at the ten percent level) direct effect of the budget deficit on inflation is reported. And the estimated coefficient (-0.000917 with a t-value of -1.66) has the expected negative sign, suggesting that the deficit contributes to a higher rate of inflation. However, this result is

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16 As Joines (1990 413) points out evidence of monetization appears stronger in studies using quarterly data than in those using annual data. He cites two possible reasons. First, it is possible that quarterly data contain more information than annual data, resulting in an increased power to reject the null hypothesis of no relation between deficits and money growth. Second, the apparent relation between deficits and money growth in quarterly data is an artifact of seasonality that has not been adequately modeled. Joines 1990 414.

17 In general estimates are unstable over time. Dwyer 1985 677.

Table 1: Existing Studies on the Relationship between Deficits and Money Growth for Switzerland

Author(s)	Dependent Variable	Sample	Deficit Measure (Source)	Results
Giannaros/Kolluri (1985)	growth rate of the money supply M1	annual 1950-1981	lagged nominal deficit (revenues minus expenditures) in percent of nominal gross national product (IFS* Yearbook line 80)	positive (0.001134) and not significant (t = 1.00)
Parkin (1987)	percentage growth rate of base money	annual 1955-1983	lagged nominal deficit (revenues minus expenditures) in percent of nominal gross national product (IFS Yearbook line 80)	positive (4.48) and significant (t = 2.34)
Burdekin/Wohar (1990)	growth rate of the monetary base	quarterly 1967.1-1985.4	lagged government budget surplus (IFS line 80) divided by gross domestic product and multiplied by -1	negative (-1.769) and not significant
Burdekin/Langdana (1992)	growth rate of the monetary base	quarterly 1966.2-1983.4	lagged government budget surplus (IFS line 80) divided by gross domestic product and multiplied by -1	negative and significant
		subsample 1966.2-1973.1		negative and significant
		subsample 1973.2-1983.4		negative and not significant
Karras (1994)	growth rate of the money supply M1	annual 1958-1989	contemporaneous federal deficit (expenditures minus revenues) as a percentage of gross domestic product (IFS line 80)	negative (-3.42) and not significant (t = -1.76)

* International Financial Statistics

not confirmed in an alternative specification where inflation is regressed on lagged money supply growth rates, lagged inflation, and the lagged budget deficit.

In his model of the money growth process for Switzerland Parkin (1987) regresses the percentage growth rate of base money on the nominal deficit expressed as a percentage of nominal GNP and lagged one period, the percentage growth rate of base money lagged one period, and the current cyclical state of the economy measured as deviations of real GNP from trend. The estimation of this equation using annual data from 1955 to 1983 indicates that the previous year's deficit has a significant positive influence on the current year's money supply growth rate.[18] Even though the significance attaching to the large positive coefficient (4.48) is weak (the t-statistic is 2.34), Parkin comments on this that "it has to be recorded that the Swiss money supply growth process has this unique feature and a feature which would be expected to be associated not with an independent central bank such as that of Switzerland but with one that is heavily dominated by the government and encouraged to accomodate past deficits." (Parkin 1987 325) However, a closer look at his data appendix suggests that the deficit is defined as the difference between revenues and expenditures (so that the deficit is a negative number). With this definition a positive coefficient is not consistent with accomodating policy. It rather indicates offsetting behavior and independence.

Burdekin/Wohar (1990) estimate monetary growth, budget deficit and inflation equations jointly as a three-equation system for eight countries, including Switzerland. Using quarterly data for the period of 1967.1 to 1985.4 they find a negative response of the monetary base growth to budget deficits for Switzerland. Their coefficient reported for the sum of all lags included is -1.769, but it fails to be significant. Since their deficit measure is the domestic government budget surplus divided by gross domestic product and multiplied by minus one, a negative coefficient suggests offsetting behavior. Combined with findings obtained by Burdekin (1987) for Switzerland, and Demopoulos/Katsimbris/Miller (1987) for West Germany they conclude that "it does seem very difficult to argue that deficit accomodation is a feature of the two countries with the most fully autonomous central banks. (Rather the relationship, if

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18 "If, however, the other two variables - the lagged money supply growth rate and the cycle are excluded from the equation, the coefficient .. drops in value and becomes insignificant at the 5 percent level." Parkin 1987 325.

anything, appears to be negative in these two cases.)" (Burdekin/Wohar 1990 545 FN 14)[19]

Again of interest are the results of their inflation equations. In these equations the inflation rate is regressed on the deficit and a series of other variables. "In Japan, Switzerland and the United Kingdom budget deficits actually appear to be deflationary - leaving perhaps relatively little support for taking deficits to be an important independent cause of inflation across the present sample of countries." (Burdekin/Wohar 1990 546)

Burdekin/Langdana (1992) - based on an earlier study by Burdekin (1987) - present an explicit case study of Swiss monetary policy. In their reaction function the growth rate of the monetary base is regressed on the federal budget deficit divided by gross domestic product, the growth rate of real government purchases (real government and social security consumption), the growth rate of consumer prices, the three-month deposit rate, unemployment (numbers unemployed in thousands), the exchange rate between the Swiss franc and the Deutschmark, the balance of trade, and lagged values of the growth rate of the monetary base. Ordinary least squares estimation results over quarterly data from 1966.2 to 1983.4 indicate the deficit, inflation and exchange rate variables to be significant at the 5 percent level. The response to the deficit is strongly negative implying an offsetting monetary policy. Allowing for a possible structural break corresponding with the adoption of floating exchange rates in January 1973, two separate reaction functions were reestimated over the fixed exchange rate (1966.2 to 1973.1) and floating exchange rate (1973.2 to 1983.4) subsamples. While the deficit is significant at the 10 percent level or higher in the fixed exchange rate subsample, it fails to be significant in the floating exchange rate subsample. Overall, the offsetting response to fiscal policy is interpreted as evidence supporting the hypothesis of formal independence of the SNB.

Karras (1994) investigates macroeconomic effects of budget deficits on money growth, inflation, investment and real output growth for 32 countries including Switzerland. To test for effects on money growth he regresses the growth rate of the money supply M1 on a constant, a lagged dependent variable, the contemporaneous federal deficit (measured as the difference between government expenditures and revenues and expressed as percentage of gross domestic product), and the real growth rate of gross domestic product lagged one period. Using annual values

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[19] Because of the number of right-hand-side variables no separate estimation is made for fixed and floating exchange rate regimes. The potential effects of changes in the exchange rate regime are controlled with exchange rate regime dummies. Burdekin/Wohar 1990 538.

for the time period from 1958 to 1989 he finds a negative coefficient for the deficit variable (-3.42) which fails to be significant at the 5 percent level (t = -1.76) for Switzerland. But his equation explains only a small part of the total variation in the dependent variable, suggesting a poor specification. (The R^2 is 0.14.) Still, the negative sign suggests offsetting behavior. Among the 32 countries, Japan is the only country where a negative and statistically significant relationship between deficits and money growth is found. Since the sample includes both fixed- and flexible-exchange rate regimes a binary variable equal to 0 (1) before (since) 1973 is used interactively with the slope coefficients to allow for potentially different effects. The results are generally unaffected by this modification.
Adopting the same definition for the deficit variable - and accepting the qualifications offered for Parkin's study - there exists a consensus in the sense that all authors find a negative (though in most cases insignificant) response of the money growth rate to the deficit. Still, there remains the question what the negative sign could imply. Does it suggest that the SNB is really trying to offset potentially harmful effects generated by the deficit? Or does it rather reflect a response of monetary policy to the business cycle? These questions are addressed in this paper by distinguishing between structural and cyclical components of the defict. The sample only extends over the period of flexible exchange rates, but it includes data until 1994.1. The structural stability of the coefficient estimates is tested. The effects of seasonality are addressed. The significance of different fiscal measures is tested while controlling for various other variables.

4. The Money Growth Equation

To test for the impact of fiscal deficits on Swiss money growth rates the following reaction function for the Swiss National Bank is specified.[20] (See table 2 for a complete list of all variables reported in this paper, as well as their definitions and sources.)

$$\begin{aligned} MB_t \quad &= \quad \beta_0 + \beta_1 MB_{t-1} + \beta_2 CPI_{t-1} + \beta_3 DMN_{t-1} + \beta_4 GDPSR_{t-1} + \\ (M1_t) \quad &\qquad \beta_5 \Delta UR_{t-1} + \beta_6 \Delta DR_{t-1} + \beta_7 DEF_{t-i} + \varepsilon_t \end{aligned}$$

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20 Here we choose the single-equation approach. The formulation of a theoretical model is beyond the scope of this paper. This has been extensively done elsewhere. See Dwyer 1985; Protopapadakis/Siegel 1987; De Haan/Zelhorst 1990. For an explicit model see Niskanen 1978.

The stance of monetary policy is proxied by two monetary aggregates, the unadjusted monetary base MB and the money supply M1. The monetary base is preferred as dependent variable for at least two reasons. First, it is considered to be under direct control of the monetary authority. A control of the money supply M1, however, can be complicated by a possible endogeneity of the money multiplier. Second, whether the central bank targets M1, interest rates, or an exchange rate, the control of these variables is achieved through policy operations that affect the monetary base as well. So even for the time period before 1980 policy actions will be measured by changes in the monetary base, although the SNB was not explicitely targeting the monetary base.[21] But for comparison, results with the growth rates of both the unadjusted[22] monetary base and the money supply M1 as dependent variables are presented.[23]

A central bank probably responds to a wide variety of interacting objectives, and it considers those objectives within the context of a structural model of the economy. (Levy 1981 352) Here the central bank is assumed to respond to inflation, exchange rates, production, unemployment, interest rates, and deficits.

Since inflation ultimately is a monetary phenomenon, the central bank is the authority responsable for price stability. It is therefore expected to react to changes in the inflation rate as measured by the consumer price index.

For small open economies like Switzerland with relatively large foreign sectors exchange rate considerations play a prominent role in monetary policy. Stabilization of exchange rates is not a goal per se, but serves to alleviate fluctuations in inflation, production, and employment. (Rich 1989 349) Since Germany is the most important trading partner, and since SNB officials frequently made statements about what the desired level of the Swiss franc/Deutschmark exchange rate would be, the central bank is expected to respond to changes in the Swiss franc/Deutschmark exchange rate.

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[21] The SNB explicitly targets the growth rate of the monetary base since 1980. From 1975 to 1978 the target was the money supply M1, and for 1979 an exchange rate target was set.

[22] The use of the unadjusted monetary base helps to avoid data limitations caused by changes in definition and adjustment procedures of this monetary aggregate. Moreover, "using a monetary base data series not seasonally adjusted, complemented by quarterly seasonal dummy variables, avoids estimating biases that may occur with seasonally adjusted data." Levy 1981 362.

[23] "In this view the money supply is endogeneous, not because it cannot be controlled to a reasonable approximation, but because the authorities have incentives to respond to various pressures in the economy such as wage push or central government deficit finance." Laney/Willett 1983 53.

Table 2: Variable Definitions and Data Sources

Variable	Definition	Source
	dependent variables	
MB	unadjusted monetary base (first differences of natural logarithms)	SNB[1]
M1	money supply M1, including Liechtenstein (first differences of natural logarithms)	KOF[2]
	deficit variables DEF*	
FDEF	federal deficit, quarterly series with saisonal pattern, including extrabudgetary transactions (mainly the railways and postal communications system)	IFS[3] line 80
FDEFE	federal deficit, as reported annually in Compte d'Etat	EFV[4]
FDEFC	federal deficit, cyclical component	BFK[5]
FDEFS	federal deficit, structural component	BFK
TDEF	total deficit (federal, cantonal, communal)	UBS[6]
TDEFC	total deficit (federal, cantonal, communal), cyclical component	UBS
TDEFS	total deficit (federal, cantonal, communal), structural component	UBS
	other control variables used as regressors	
CPI	consumer price index, 1977=100 (first differences of natural logarithms)	BFS[7]
DMN	Swiss franc/Deutschmark exchange rate index, nominal, November 1977=100 (first differences of natural logarithms)	SNB
DR	deposit rate: rate of interest on three-month deposits with large banks (first differences)	SNB
GDPSR	gross domestic product, seasonally adjusted, real (first differences of natural logarithms)	BFK
UR	unemployment rate: registered unemployed as percentage of total labor force (first differences)	BIGA[8]

* All deficit variables are defined as the difference between expenditures and revenues. FDEFC and TDEFC are divided by saisonally adjusted nominal gross domestic product. FDEFE, FDEFS, TDEF and TDEFS are divided by saisonally adjusted nominal gross domestic product and are expressed as first differences. FDEF is the federal deficit divided by unadjusted nominal gross domestic product and expressed as first differences.

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2 Konjunkturforschungsstelle Eidgenössische Technische Hochschule Zürich
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Monetary policy can influence real economic activity as measured by production and employment at least in the short run. The change in gross domestic product and in the unemployment rate are therefore included in the reaction function to see whether the SNB is responsive to changes in real economic activity.[24]
The central bank is assumed to smooth interest rate fluctuations, because it is aware of the adverse impact of these fluctuations on the economy.
For the reasons discussed in section 2 the central bank is also alleged to respond to deficits. Since the focus here is on political (in)dependence of the central bank, fiscal deficits at the federal level appear to be the appropriate measures. However, cantons too might pressure the central bank to monetize deficits. Therefore, a measure of the total deficit (the sum of federal, cantonal and communal deficits) is also used. In all regressions the budget deficit is defined as the difference between government expenditures and revenues,[25] so that a deficit is a positive number. This definition makes it more convenient to discuss the estimation results for the deficit. (see e. g. Dwyer 1985 669 FN 19) Following common practice the deficit measures are expressed as a proportion of nominal gross domestic product.[26]
The actually measured deficit is divided up into a cyclical and a structural component. Significance of the structural component can be interpreted as evidence on the (in)dependence debate. A politically independent central bank that is preoccupied with price stability will try to offset any inflationary effects of fiscal deficits. Therefore, a negative sign for the coefficient of the structural deficit is hypothesized. A significant positive coefficient would indicate monetization and suggest political dependence, however.[27] Significance of the cyclical component suggests (positive or negative) correlation of monetary policy with the business cycle. While negative correlation implies offsetting behavior that suggests political independence, positive

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24 "If Milton Friedman's suggested monetary policy had been followed, the coefficient on GNP would approximate the expected growth in real national income (adjusted for a monetary base multiplier), and all of the other variables in the model would be zero and insignificant." Levy 1981 361.

25 Despite some well-founded and constructive criticism of these conventional deficit measures (see e. g. Jordan 1994), this standard definition remains the one most frequently used, also because of data availability. Karras 1994 208 FN 2.

26 An alternative measure would be the first difference of the natural logarithm of federal government gross debt (end of period). See e. g. Landon/Reid 1990 388.

27 If the central bank "decides to monetize all or some portion of the fiscal authority's deficit, then the growth of nominal high-powered money would be, at least partially, determined by the growth of nominal government debt and the deficit variable would have a significant positive impact on monetary expansion." Landon/Reid 1990 383.

correlation implies accomodating behavior and can be interpreted as a sign of political dependence.
However, predictions of signs for coefficients estimated from a single-equation reaction function have to be interpreted with care. (See e.g. Alt/Chrystal 1983 chap. 6; Missong/Herrault 1990.) Coefficient estimates combine information on policymakers' preferences along with parameters of the reduced-form equations that describe the economy. Inferences about policymakers' preferences could only be derived if the central bank's objective function and its structural model of the economy were identified. A significant coefficient on a deficit variable means that this variable helps to explain money growth. But no unique meaning can be ascribed to it. Therefore, it can only be argued that the sign *is consistent* with political (in)dependence, thus emphasizing the fact that it can be consistent with other arguments that are not even related to political (in)dependence.
While all other regressors are simply lagged one quarter, the deficit variables enter with four lags. Adding more lags for the deficit variables does not change the estimation results. A contemporaneous measure of the deficit is not included because of a possible simultaneity bias. Including only one lag (the one that performs best) may not be appropriate, because the central bank may distribute its response to the fiscal stimulus over a longer time period.
A lagged dependent variable is also included to pick up elements of serial dependence and effects from omitted variables. (see e. g. Barro 1977 104; Laney/Willett 1983 55)
All equations include a set of dummy variables to capture seasonal variation.

5. The Data

In an empirical investigation of the relationship between deficits and money growth there are at least three reasons why the data might produce the appearance of a positive correlation between the two series. None of them implies monetization of the deficit. When testing the hypothesis whether the central bank monetizes the deficit allowance must be made for these features of the data.
First, both series might simply reflect the business cycle and may in fact not be directly related. This problem can be addressed by splitting the actual deficit in its cyclical and structural components and - since the structural component is uncorrelated with the business cycle - testing for the significance of the structural component. Data on the cyclically adjusted deficit for Switzerland are available only since very recently. Series for the

federal government are provided by the Swiss Bundesamt für Konjunkturfragen.[28] The structural component does not excactly correspond to the definition of the full-employment deficit (which is usually used in studies for the Federal Reserve), since it is not calculated on the basis of potential gross domestic product, but on the basis of the trend growth of gross domestic product. The cyclical component which measures the changes in the deficit caused by the business cycle accounts for particularities of the Swiss tax system, too. Series for the total of federal, cantonal and communal deficits are provided by Schwab (1993, 1994b).

Second, spurious correlation between deficits and money growth may arise because of a common upward trend in both series over the sample period. But this rise in monetary growth does not necessarily reflect a decision to monetize the increasing deficits either. There are other plausible interpretations. (Joines 1990 429; Cagan 1985 215) One possibility is that of reversed causality: The fiscal authority increases nominal budget deficits in response to higher rates of money growth and inflation, e. g. because it seeks to keep the real value of the public debt from being affected by inflation. Another possibility is that the upward drift in the two series occurred for totally unrelated reasons.[29] The inclusion of a time trend in a regression of the money growth rate on the deficit reduces this tendency of spurious results. But as Nelson/Kang (1984) showed it does not eliminate the problem. Spurious estimation can be avoided if the series are stationary. Augmented Dickey-Fuller tests indicate that the money growth rates and the other control variables used as regressors are stationary, but that most deficit series are not.[30] Table 3 reports the results of various stationarity tests for the deficit variables. (The test results for the other variables are not given here in order to preserve space.) Only the cyclical components of the federal and the total deficit (the sum of the federal, cantonal, and communal deficits) can be assumed to be stationary when measured as ratios (i.e. when divided by GDP). Most other deficit variables can be assumed to be stationary after taking the first differences of the ratios. Therefore, all

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[28] See Amman 1995.

[29] The tendency for two independent, integrated time series to appear related has been pointed out by Granger/Newbold 1974.
As Joines (1990 436) reports, Monte Carlo simulation results indicate that, given the time-series properties of the two variables, an apparent relation as strong as that found in his paper could easily result by chance even if the two series were independent.

[30] "A nonstationary time series is usually a linear function of time that has no unique mean and an infinite variance. Thus, any test statistics from a nonstationary series are biased." Havrilesky/Granato 1993 259 FN 7.

deficit variables except the cyclical components of the federal and total deficit enter the regression equations as first differences.[31] The only variable which is not stationary even in first differences is the total deficit TDEF.

Table 3: Dickey Fuller Tests for Stationarity of Deficit Variables

	Ratios[1]			First Differences[2]		
Variable	ADF	ADF + const.	ADF + trend	ADF	ADF + constant	ADF + trend
FDEF	-1.99** (0.046)	-2.61* (0.096)	-2.32 (0.431)	-5.43*** (0.001)	-5.40*** (0.001)	-5.56*** (0.001)
FDEFE	-1.07 (0.242)	-1.54 (0.487)	-0.83 (0.957)	-2.54** (0.012)	-2.55 (0.109)	-2.93 (0.165)
FDEFC	-3.35*** (0.001)	-3.37** (0.015)	-3.35* (0.064)	-2.25** (0.025)	-2.39 (0.151)	-2.41 (0.391)
FDEFS	-1.35 (0.159)	-1.64 (0.444)	-0.95 (0.944)	-3.33*** (0.001)	-3.30** (0.018)	-3.79** (0.022)
TDEF	1.32 (0.952)	0.91 (0.99)	1.64 (0.99)	-1.25 (0.187)	-1.42 (0.543)	-2.60 (0.299)
TDEFC	-2.65*** (0.001)	-2.74* (0.07)	-2.70 (0.256)	-1.65* (0.092)	-1.70 (0.416)	-1.67 (0.745)
TDEFS	0.72 (0.862)	0.22 (0.972)	0.20 (0.99)	-2.06** (0.039)	-2.14 (0.235)	-3.11 (0.111)

1 Deficit divided by gross domestic product.
2 First differences of these ratios.

Statistics are for 1973.2-1994.1. ADF is the augmented Dickey-Fuller test for stationarity with four autoregressive terms added to the regression. Numbers in parentheses are associated p values. Asterisks (*) indicate stationarity: * significant at 10 percent level, ** significant at 5 percent level, *** significant at 1 percent level.

31 Lang/Welzel (1992 75) and Beck (1987) also use first differences for the deficit variables.

Third, an apparent positive relationship between deficits and money growth in quarterly data[32] could be an artifact of seasonality in the two series. (see Joines 1990 on this) Similarity of the two seasonal patterns could result in high correlation of the deficit and money growth even if these patterns arise for completely different reasons. Moreover, a seasonal pattern in money growth that is entirely due to accomodation of seasonal variation in the deficit need not imply that monetization of the deficit is an important economic phenomenon, since the seasonal variation in the two series can be purely transitory and sum to zero over the course of a year.[33] Including seasonal dummy variables in the regression of money growth on the deficit will not adequately remove the seasonal correlation if the seasonal patterns in the two series shift over time.[34] To remove all correlation due to seasonality, the seasonal patterns in deficits and money growth would have to be modeled explicitely.[35] The quarterly series on Swiss federal deficits provided by IFS and the growth rates of the unadjusted monetary base both exhibit seasonal patterns, so that seasonality could indeed cause spurious correlation between deficits and monetary base growth. The problem is indirectly addressed in this paper by using deficit variables with and without a seasonal pattern, and by allowing seasonal patterns to shift over time.

One objective of this study is to test for structural breaks in the deficit money growth relationship. Since the ability to test for structural stability of a model is limited by the use of annual data (Allen/Smith 1983 606), quarterly data are used.[36] Except for the series provided by IFS, all deficit variables are available on an annual basis only. Quarterly estimates are interpolated from these annual series using three conversion methods, cubic spline interpolation (by fitting a cubic spline curve to the annual series), linear interpolation (producing a linear spline), and

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[32] This problem obviously does not affect studies using annual data.

[33] For this reason the deficit variables enter the regression with several lags.

[34] "There are two very general reasons why the seasonal pattern of an economic time series may change. First, the seasonal pattern of one or more components of the series may change. Second, the components of a series may have different seasonal patterns (each of which may remain constant over time) and the shares of these components in the total may change." Joines 1990 420.

[35] Joines (1990 422) models several components of the deficit separately, decomposing each into a seasonal factor and a nonseasonal portion. The seasonal factors and the nonseasonal portion of the deficit enter the money growth equations separately.

[36] There exist other arguments for using quarterly instead of annual data. Annual data for instance do not capture short-run variations in monetary and fiscal policy and in economic conditions. Annual data can make it more difficult to ascribe one-way causality to the estimated coefficients.

discontinuous piecewise constant curve fitting (resulting in a step function). Experimenting with all three conversion methods yields very similar results, so that it is decided to limit the analysis to cubic splines (though in some cases a step function or a linear spline performs better than the cubic spline).
Table 4 reports summary statistics for all quarterly deficit variables. Taking first differences of the deficit series interpolated from a cubic spline function (all series except FDEF, FDEFC and TDEFC) leads to very small values. This explains the large coefficient estimates that result in some regressions.

Table 4: Summary Statistics for Deficit Variables*

Variable	N	Mean	Std Dev	Minimum	Maximum
FDEF	84	0.000515	0.030123	-0.084607	0.070454
FDEFE	84	0.000251	0.001750	-0.004429	0.004727
FDEFC	84	0.000431	0.004104	-0.007892	0.015300
FDEFS	84	0.000063	0.001525	-0.003822	0.003935
TDEF	83	0.000488	0.002362	-0.004536	0.008544
TDEFC	83	-0.00252	0.004585	-0.009461	0.009110
TDEFS	83	0.000354	0.002550	-0.005440	0.007364

* For variable definitions see table 2.

Table 5 contains the correlation coefficients for all regressor variables used in this paper. Since correlation analysis is the equivalent to a bivariate regression with the intercept set equal to zero correlation coefficients provide rather limited information. Nevertheless, they can be used as benchmarks for the strength of the *linear* relationship between a pair of variables. The correlation between the federal and total deficit series is positive, but the coefficients for the cyclical and structural components are rather small (0.36 and 0.40). Both cyclical deficit measures are negatively correlated with the consumer price index. But it is interesting to note that they show no correlation with the other control variables, especially with the saisonally adjusted real growth rate of gross domestic product. This can be explained with the lag caused by the fact that taxes are filed every two years and paid on the basis of the average income earned in the past two years.

Table 5: Correlation Matrix for Regressor Variables

	FDEF	FDEFE	FDEFC	FDEFS	TDEF	TDEFC	TDEFS	CPI	DMN	DR	GDPSR
FDEFE	0.104 (0.347)										
FDEFC	0.028 (0.800)	0.211 (0.054)									
FDEFS	-0.010 (0.931)	0.298 (0.006)	-0.239 (0.029)								
TDEF	0.078 (0.485)	0.744 (0.001)	0.225 (0.041)	0.480 (0.001)							
TDEFC	0.001 (0.992)	0.021 (0.850)	0.360 (0.001)	-0.034 (0.759)	0.035 (0.751)						
TDEFS	0.083 (0.456)	0.583 (0.001)	0.092 (0.408)	0.401 (0.001)	0.898 (0.001)	-0.041 (0.716)					
CPI	-0.004 (0.972)	0.158 (0.151)	-0.300 (0.006)	0.120 (0.278)	0.186 (0.092)	-0.258 (0.019)	0.286 (0.009)				
DMN	0.001 (0.993)	-0.159 (0.148)	0.100 (0.363)	-0.100 (0.365)	-0.040 (0.718)	0.141 (0.202)	-0.120 (0.280)	-0.136 (0.218)			
DR	0.084 (0.446)	-0.174 (0.114)	-0.077 (0.486)	-0.091 (0.408)	-0.100 (0.372)	0.118 (0.289)	-0.008 (0.942)	0.087 (0.430)	-0.118 (0.285)		
GDPSR	0.081 (0.462)	-0.157 (0.153)	0.024 (0.828)	0.107 (0.335)	-0.086 (0.439)	0.121 (0.275)	-0.070 (0.532)	-0.201 (0.067)	-0.226 (0.039)	0.318 (0.003)	
UR	-0.005 (0.962)	0.405 (0.001)	0.164 (0.136)	0.143 (0.194)	0.305 (0.005)	-0.106 (0.340)	0.166 (0.134)	0.100 (0.365)	-0.125 (0.256)	-0.350 (0.001)	-0.264 (0.015)

Numbers in parentheses are p values (significance probability of the correlation under the null hypothesis that the statistic is zero).

Figure 1 presents a plot of the annual deficit series provided by IFS (FDEF) and the annual deficit as reported in the Compte d'Etat (FDEFE). The difference in these two annual series arises from the fact that the IFS data include extrabudgetary transactions, mainly the railways and postal communications system. The Pearson correlation coefficient between these two annual series is 0.90. As can be seen the federal deficit decreases during the second half of the seventies (with the exception of 1979) and is small during the first half of the eighties. A period of budget surpluses between 1986 and 1990 is followed by a dramatic rise in the size of the federal deficit after 1990. The total deficit TDEF (not plotted here) follows a very similar pattern. The Pearson correlation coefficient with the federal deficit FDEFE is 0.81.
Figure 1 helps to interprete the regression results. Notice that in Figure 1 the annual deficit is defined as revenues minus expenditures, so that the deficit is a negative number.

6. Estimation Results

First, the reaction function is estimated excluding the deficit variables.[37] Although the analysis extends over the flexible exchange rate era only, the sample is divided up into subperiods of different "regimes" based on a priori information.[38] All intercept and slope coefficients - including the seasonal dummies - are allowed to differ for each "regime". F tests for nested models are used to identify possible structural breaks. These tests confirm a "regime" shift at the beginning of 1980. Inspection of the residuals from the estimated regressions incorporating the shift for 1980 serves to determine whether the errors are nonspherical and whether this nonsphericalness is due to heteroskedasticity or autocorrelation. In the regressions with the growth rate of the money supply M1 as dependent variable no autocorrelation and no heteroskedasticity can be detected, so that equations are OLS estimates. In the regressions with the growth rate of the monetary base as dependent variable diagnostic tests (Q tests, Lagrange multiplier tests, Durbin-Watson tests) indicate heteroskedasticity, but no autocorrelation.

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[37] For a detailed outlining of the estimation procedure see Jeitziner 1995 38-40.

[38] This procedure might be criticized as being somewhat arbitrary. One alternative for choosing the breakpoints would be to search for the exact sample split that maximizes the Chow test statistic. (Allen/Smith 1983) Another alternative would be to let the data determine structural breaks by estimating random coefficient models.

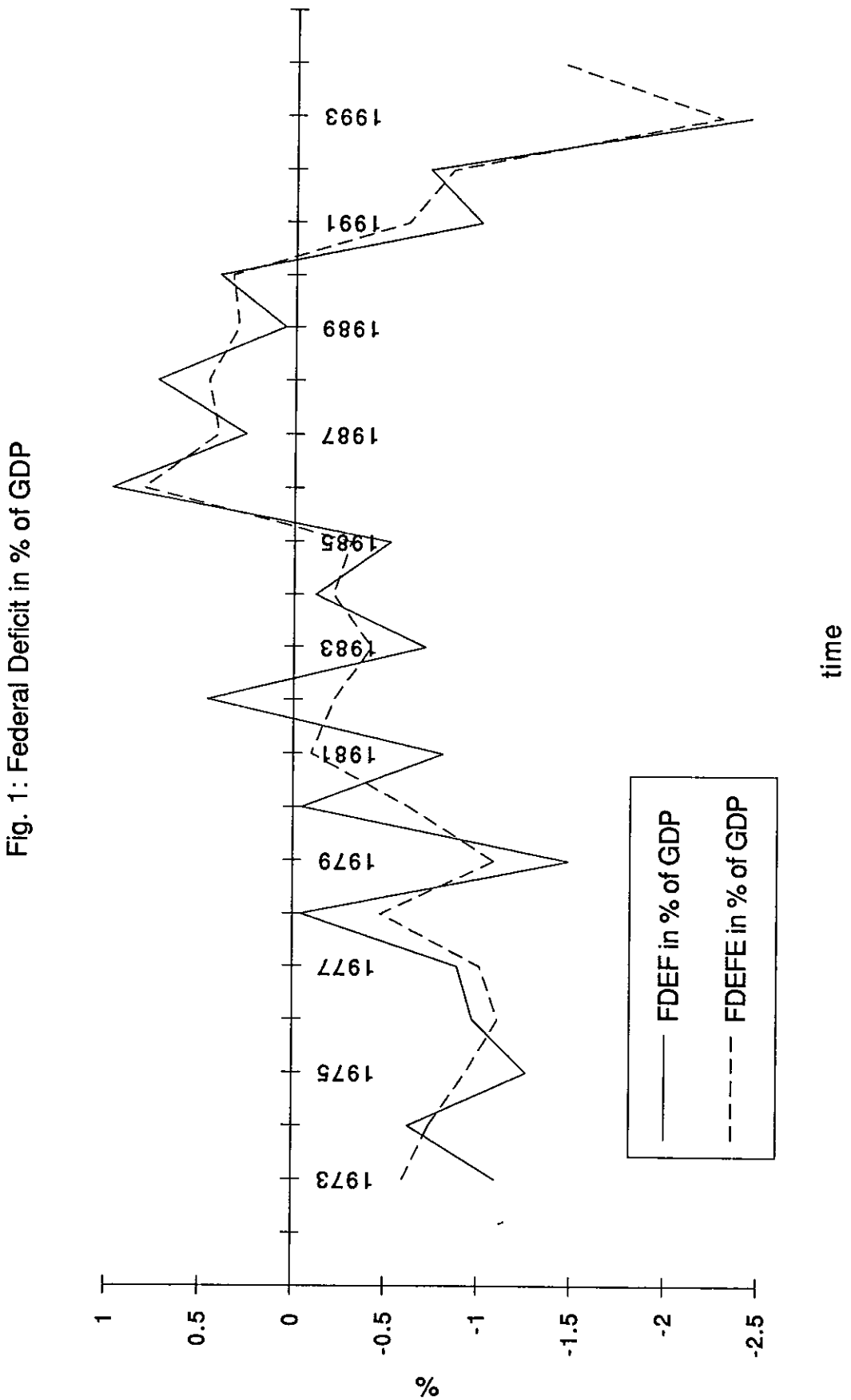

Fig. 1: Federal Deficit in % of GDP

In order to correct for the inefficiency of the OLS estimates in the presence of heteroskedasticity the equations are estimated using weighted least squares. The weights are determined on the basis of the conditional standard errors of a simple GARCH(1,1) model estimated on the residuals of the OLS regression with the regime shift for 1980 incorporated. For observations before 1979.4 and between 1988.1 and 1989.3 the conditional standard errors are approximately three times larger than for the rest of the observations. Hence, a weight of 1/9 is given to these observations to reduce their influence. All other observations have weight one. Estimation results for the two dependent variables are reported in table 6.

Then the various deficit variables are added to these reaction functions with four lags each.[39] Regression results for the different deficit variables are reported in tables 7 to 10. (The coefficient estimates for the other control variables reported in table 6 are not repeated in order to preserve space.) Equation 3 includes the IFS deficit variable FDEF, which exhibits a distinct seasonal pattern (and which includes extrabudgetary transactions). In equation 4 the federal deficit variable FDEF provided by IFS is replaced by the actually measured federal deficit FDEFE, as it is reported in the Compte d'Etat, and interpolated from a cubic spline function. In equation 5 the total deficit for federal, cantonal and communal levels TDEF enters the reaction function. In equation 6 the actually measured federal deficit is splitted into its cyclical and structural components. Equation 7 reports regression results with the total deficit for federal, cantonal and communal levels splitted into cyclical and structural components, too.

In equations 3 to 7 (tables 7 and 8) the dependent variable is the growth rate of the monetary base. Equations 8 to 12 (tables 9 and 10) are the regressions with the same deficit variables, but with the growth rate of the money supply M1 as dependent variable.

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[39] A reaction function that includes fiscal variables only could also be estimated. This would imply that all of the growth rate of the monetary aggregate is either related to the deficit or is due to the error term. "While this is possible, such a simple specification does not seem particularly plausible." Dwyer 1985 670.

Table 6: Regression Results Assuming One Structural Break for 1980 - Excluding Fiscal Variables

	Eq. 1: Monetary Base MB		Eq. 2: Money Supply M1	
Variables	Coefficients	p values	Coefficients	p values
Constant				
73.2-79.4	0.079***	(0.0001)	0.060***	(0.0001)
80.1-94.1	0.039***	(0.0001)	0.069***	(0.0001)
$MB_{t-1}/M1_{t-1}$				
73.2-79.4	0.011	(0.9389)	-0.024	(0.8957)
80.1-94.1	0.115	(0.5073)	0.245	(0.1060)
CPI_{t-1}				
73.2-79.4	-2.305***	(0.0028)	-1.433***	(0.0004)
80.1-94.1	-0.332	(0.2474)	-0.610	(0.1536)
DMN_{t-1}				
73.2-79.4	0.941***	(0.0001)	0.428***	(0.0004)
80.1-94.1	-0.101	(0.2725)	0.120	(0.3582)
$GDPSR_{t-1}$				
73.2-79.4	-0.694	(0.1233)	-0.194	(0.3829)
80.1-94.1	-0.481*	(0.0537)	-0.700*	(0.0567)
ΔUR_{t-1}				
73.2-79.4	0.035	(0.6328)	0.009	(0.8075)
80.1-94.1	-0.008	(0.4089)	-0.003	(0.8283)
ΔDR_{t-1}				
73.2-79.4	0.038***	(0.0053)	0.0007	(0.9214)
80.1-94.1	-0.002	(0.2929)	-0.008**	(0.0314)
DF	64		64	
Root MSE	0.01175		0.01762	
F Value	10.596	(0.0001)	17.44	(0.0001)
R^2	0.77		0.84	
adj. R^2	0.70		0.80	

Eq. 1 are weighted LS results with all observations before 1979.4 and between 1988.1 and 1989.3 given a weight of 1/9, all other observations have weight 1. Eq. 2 are OLS results. Eq. 1 and 2 include three saisonal dummies which are also allowed to change across the two subperiods. * significant at 10 percent level; ** significant at 5 percent level; *** significant at 1 percent level.

Table 7: Actually Measured Deficits and Monetary Base Growth

	Eq. 3 FDEF	Eq. 4 FDEFE	Eq. 5 TDEF
sum 70 lag 1-4	2.51	29.34	21.47
H1 sum 70=0	$F_{(1,56)}$=0.66 (0.4215)	$F_{(1,56)}$=4.93** (0.0305)	$F_{(1,56)}$=5.63** (0.0211)
sum 80 lag 1-4	-0.22	-0.17	-1.13
H2 sum 80=0	$F_{(1,56)}$=0.16 (0.6886)	$F_{(1,56)}$=0.007 (0.9324)	$F_{(1,56)}$=1.28 (0.2636)
H3 all=0	$F_{(8,56)}$=1.72 (0.1150)	$F_{(8,56)}$=2.35** (0.0297)	$F_{(8,56)}$=2.23** (0.0386)
H4 70s=0	$F_{(4,56)}$=1.97 (0.1117)	$F_{(4,56)}$=3.79*** (0.0085)	$F_{(4,56)}$=3.74*** (0.0092)
H5 80s=0	$F_{(4,56)}$=1.46 (0.2265)	$F_{(4,56)}$=0.91 (0.4675)	$F_{(4,56)}$=0.72 (0.5820)
H6 70s=80s	$F_{(4,56)}$=1.57 (0.1962)	$F_{(4,56)}$=4.10*** (0.0055)	$F_{(4,56)}$=3.40** (0.0146)
DF	56	56	56
Root MSE	0.01126	0.01087	0.01094
F Value	8.735 (0.0001)	9.516 (0.0001)	9.367 (0.0001)
R^2	0.81	0.83	0.82
adj. R^2	0.72	0.74	0.74

Equations are weighted LS results with all observations before 1979.4 and between 1988.1 and 1989.3 given a weight of 1/9, all other observations have weight 1. All equations include a lagged dependent variable, the consumer price index, the Deutschmark/Swiss franc exchange rate, the seasonally adjusted real growth rate, the first difference of the unemployment rate, the first difference of the three-month deposit rate (all lagged one quarter), and three seasonal dummies. All variables are allowed to change across the two subperiods. Numbers in parentheses are associated p values. * significant at 10 percent level; ** significant at 5 percent level; *** significant at 1 percent level. See text for an exact statement of the null hypotheses.

Table 8: Structural and Cyclical Measures of the Deficit and Monetary Base Growth

	Eq. 6		Eq. 7	
	FDEFC	FDEFS	TDEFC	TDEFS
sum 70 lag 1-4	-8.86	30.96	-1.64	32.01
H1 sum 70=0	$F_{(1,48)}$=3.77* (0.0582)	$F_{(1,48)}$=5.78** (0.0201)	$F_{(1,48)}$=0.34 (0.5600)	$F_{(1,48)}$=5.14** (0.0280)
sum 80 lag 1-4	0.75	-4.07	-0.91	-0.96
H2 sum 80=0	$F_{(1,48)}$=0.3704 (0.5457)	$F_{(1,48)}$=2.56 (0.1160)	$F_{(1,48)}$=2.64 (0.1105)	$F_{(1,48)}$=1.03 (0.3148)
H3 all=0	$F_{(8,48)}$=1.67 (0.1317)	$F_{(8,48)}$=3.63*** (0.0022)	$F_{(8,48)}$=2.15** (0.0485)	$F_{(8,48)}$=2.86** (0.0107)
H4 70s=0	$F_{(4,48)}$=2.51* (0.0542)	$F_{(4,48)}$=5.10*** (0.0017)	$F_{(4,48)}$=3.14** (0.0225)	$F_{(4,48)}$=4.62*** (0.0031)
H5 80s=0	$F_{(4,48)}$=0.82 (0.5175)	$F_{(4,48)}$=2.17* (0.0869)	$F_{(4,48)}$=1.16 (0.3387)	$F_{(4,48)}$=1.14 (0.3507)
H6 70s=80s	$F_{(4,48)}$=2.64** (0.0452)	$F_{(4,48)}$=5.90*** (0.0006)	$F_{(4,48)}$=3.32** (0.0175)	$F_{(4,48)}$=4.08*** (0.0063)
H7 c=s all	$F_{(8,48)}$=3.11*** (0.0066)		$F_{(8,48)}$=2.50** (0.0233)	
H8 c=s 70s	$F_{(4,48)}$=3.31** (0.0180)		$F_{(4,48)}$=3.95*** (0.0075)	
H9 c=s 80s	$F_{(4,48)}$=2.91** (0.0310)		$F_{(4,48)}$=1.05 (0.3906)	
DF	48		48	
Root MSE	0.00988		0.01061	
F Value	9.515 (0.0001)		8.061 (0.0001)	
R^2	0.88		0.86	
adj. R^2	0.78		0.75	

See notes on table 7.

Table 9: Actually Measured Deficits and the Growth Rate of the Money Supply M1

	Eq. 8 FDEF	Eq. 9 FDEFE	Eq. 10 TDEF
sum 70 lag 1-4	-0.25	-2.98	-0.38
H1 sum 70=0	$F_{(1,56)}$=0.02 (0.8827)	$F_{(1,56)}$=0.12 (0.7354)	$F_{(1,56)}$=0.01 (0.9411)
sum 80 lag 1-4	0.68	0.30	-1.13
H2 sum 80=0	$F_{(1,56)}$=0.79 (0.3774)	$F_{(1,56)}$=0.01 (0.9227)	$F_{(1,56)}$=0.58 (0.4514)
H3 all=0	$F_{(8,56)}$=0.95 (0.4877)	$F_{(8,56)}$=0.81 (0.5995)	$F_{(8,56)}$=1.46 (0.1930)
H4 70s=0	$F_{(4,56)}$=1.14 (0.3466)	$F_{(4,56)}$=1.20 (0.3225)	$F_{(4,56)}$=2.16* (0.0849)
H5 80s=0	$F_{(4,56)}$=0.75 (0.5630)	$F_{(4,56)}$=0.42 (0.7959)	$F_{(4,56)}$=0.75 (0.5590)
H6 70s=80s	$F_{(4,56)}$=1.48 (0.2211)	$F_{(4,56)}$=1.31 (0.2772)	$F_{(4,56)}$=2.45* (0.0566)
DF	56	56	56
Root MSE	0.01768	0.01784	0.01713
F Value	12.639 (0.0001)	12.384 (0.0001)	13.586 (0.0001)
R^2	0.86	0.86	0.87
adj. R^2	0.80	0.79	0.81

Equations are OLS results. All equations include a lagged dependent variable, the consumer price index, the Deutschmark/Swiss franc exchange rate, the seasonally adjusted real growth rate, the first difference of the unemployment rate, the first difference of the three-month deposit rate (all lagged one quarter), and three seasonal dummies. All variables are allowed to change across the two subperiods. Numbers in parentheses are associated p values. * significant at 10 percent level; ** significant at 5 percent level; *** significant at 1 percent level. See text for an exact statement of the null hypotheses.

Table 10: Structural and Cyclical Measures of the Deficit and the Growth Rate of the Money Supply M1

	Eq. 11		Eq. 12	
	FDEFC	FDEFS	TDEFC	TDEFS
sum 70 lag 1-4	-2.84	1.57	-0.75	0.46
H1 sum 70=0	$F_{(1,48)}$=1.19 (0.2815)	$F_{(1,48)}$=0.02 (0.8792)	$F_{(1,48)}$=0.27 (0.6013)	$F_{(1,48)}$=0.004 (0.9519)
sum 80 lag 1-4	1.64	-0.76	-0.04	-1.14
H2 sum 80=0	$F_{(1,48)}$=0.63 (0.4310)	$F_{(1,48)}$=0.04 (0.8461)	$F_{(1,48)}$=0.002 (0.9636)	$F_{(1,48)}$=0.55 (0.4629)
H3 all=0	$F_{(8,48)}$=1.30 (0.2667)	$F_{(8,48)}$=1.39 (0.2270)	$F_{(8,48)}$=0.91 (0.5138)	$F_{(8,48)}$=1.15 (0.3475)
H4 70s=0	$F_{(4,48)}$=1.92 (0.1230)	$F_{(4,48)}$=1.97 (0.1141)	$F_{(4,48)}$=0.86 (0.4968)	$F_{(4,48)}$=2.01 (0.1080)
H5 80s=0	$F_{(4,48)}$=0.68 (0.6080)	$F_{(4,48)}$=0.80 (0.5307)	$F_{(4,48)}$=0.97 (0.4328)	$F_{(4,48)}$=0.29 (0.8812)
H6 70s=80s	$F_{(4,48)}$=2.22* (0.0812)	$F_{(4,48)}$=1.43 (0.2394)	$F_{(4,48)}$=1.50 (0.2158)	$F_{(4,48)}$=1.88 (0.1286)
H7 c=s all	$F_{(8,48)}$=1.26 (0.2863)		$F_{(8,48)}$=0.82 (0.5924)	
H8 c=s 70s	$F_{(4,48)}$=1.85 (0.1341)		$F_{(4,48)}$=1.20 (0.3211)	
H9 c=s 80s	$F_{(4,48)}$=0.67 (0.6180)		$F_{(4,48)}$=0.43 (0.7884)	
DF	48		48	
Root MSE	0.01751		0.01769	
F Value	10.271 (0.0001)		10.042 (0.0001)	
R^2	0.89		0.88	
adj. R^2	0.80		0.79	

See notes on table 9.

The different deficit measures are used not only to check the generality of the results, but to test several hypotheses. For all equations (except equations 1 and 2) the following null hypotheses are being tested (expressions in parentheses refer to abbreviations used in tables 7 to 10):

H1: (sum 70=0)
The sum of the coefficients of the lagged deficit variables for the subperiod from 1973.2 to 1979.4 is equal to zero.

H2: (sum 80=0)
The sum of the coefficients of the lagged deficit variables for the subperiod from 1980.1 to 1994.1 is equal to zero.

H3: (all=0)
All coefficients of the lagged deficit variables for the time period from 1973.2 to 1994.1 are equal to zero.

H4: (70s=0)
All coefficients of the lagged deficit variables for the subperiod from 1973.2 to 1979.4 are equal to zero.

H5: (80s=0)
All coefficients of the lagged deficit variables for the subperiod from 1980.1 to 1994.1 are equal to zero.

H6: (70s=80s)
The coefficients of the lagged deficit variables are equal for the two subperiods (homogeneity of the coefficient estimates).

For equations 6, 7, 11 and 12 where the deficit variable is splitted into its cyclical and structural components three additional null hypotheses are being tested:

H7: (c=s all)
The coefficients for the cyclical and structural components of the deficit variables are equal for the whole sample period.

H8: (c=s 70s)
The coefficients for the cyclical and structural components of the deficit variables are equal for the subperiod from 1973.2 to 1979.4.

H9: (c=s 80s)
The coefficients for the cyclical and structural components of the deficit variables are equal for the subperiod from 1980.1 to 1994.1.

Estimation results are very different for the two dependent variables. With the growth rate of the money supply M1 as dependent variable deficits have virtually no impact on monetary policy. The only exception is equation 10 with the total deficit TDEF, where at least one of the four lags included is significantly (at the ten percent level) different from zero for the subperiod from 1973.2 to 1979.4 (H4). Accordingly, the coefficient

estimates are found to be heterogeneous for the two subperiods (H6).

With monetary base growth as dependent variable the federal deficit measure provided by IFS also fails to be significant. However, the response to the federal and total deficits as well as to their cyclical and structural components is significant for the subperiod from 1973.2 to 1979.4 (H1). For the cyclical component of the total deficit (equation 7) at least one of the four lags included is significantly (at the five percent level) different from zero (H4), but this relationship seems to be transitory since the sum of the four lags is not significant (H1). While the positive sign on the sum of the coefficients for the actually measured deficits and their structural components suggests an accomodating monetary policy, the negative sign on the cyclical component of the federal deficit indicates an offsetting behavior. For the subperiod from 1980.1 to 1994.1 the response of the monetary base is negative (with the exception of the cyclical component of the federal deficit in equation 6), but it fails to be significant.

Test results for hypotheses three to six confirm these findings. The response of the monetary base to the federal and total deficits and to their cyclical and structural components differs for the two subperiods (H6 for equations 4 to 7).

Test results for hypotheses seven to nine suggest that the origin of the deficit matters for the federal measure (equation 6), and also for the total measure (equation 7) if the subperiod from 1973.2 to 1979.4 is considered. In these cases the response to the cyclical and structural components of the federal and total deficit differs not only in magnitude, but also in sign. For these variables it appears therefore not correct to use the actually measured deficit (which implicitely imposes the restriction that the effect of the two components on money growth is equal), or to use only the structural component (imposing the restriction that the coefficient on the cyclical component of the deficit is zero). However, for the period after 1980 a distinction between the cyclical and structural component of the total deficit measure does not appear necessary.

A comparison of the equations with and without the deficit variables included shows how the overall fit of the models changes. Adding the deficit variables to the M1 models does not change the adjusted R^2. However, the inclusion of the deficit variables does improve the overall fit of the monetary base models. In equation 6 for instance the adjusted R^2 increases by 0.08 compared to equation 1. In all equations the size of the estimated coefficients on the other control variables hardly changes and the pattern of significance is not affected.

Overall, deficits do not seem to affect the growth rate of the money supply M1. However, the actual measures of the federal and total deficit and their structural components are associated with a faster growth rate of the monetary base for the subperiod from 1973.2 to 1979.4. And there are indications of a negative relationship between the cyclical component of the federal deficit and the monetary base growth. For the subperiod after 1980 all deficit measures except one (FDEFC in equation 6) show a negative sign, but none is significant. The following remarks may help to interprete these results.

First, it has to be noted that fiscal policy tended to be rather conservative in Switzerland. As figure 1 shows, deficits are relatively small, on average they are even balanced for the period from 1980 to 1990. Inflation as a result of an aggregate demand stimulus generated by deficit spending is unlikely.[40] Only in the nineties did deficits - especially the structural component - increase dramatically. But that time period is too short to have an impact on the regression results.

Second, there is no evidence that government deficits are associated with higher interest rates in Switzerland. One explanation is provided by the capital-inflow hypothesis. Interest rates for Switzerland are mainly determined by capital flows on the international level. (Schwab 1994a 13) Another explanation may be the fact that saving is traditionally high in Switzerland. Hence, deficits do not generate financial market pressure.

Third, the shift toward targeting monetary aggregates after 1975 and especially the monetary base since 1980 may serve as an additional explanation why monetary policy is not responsive to fiscal deficits in the subperiod after 1980. Remember that it is the preoccupation with the stabilization of interest rates (the targeting of interest rates) that pressures the central bank into monetizing the deficit. The shift toward monetary targeting was also supposed to end such a reaction by decoupling the conduct of monetary policy from interest-rate movements.[41]

How do these results compare with the previous studies discussed in section 3? The IFS data used in those studies are never significant in the present investigation. Using other deficit measures, indications of an offsetting behavior can only be found

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40 In this context expectations might play a role. See e.g. Baltensperger/Böhm 1984 8; Burdekin/Wohar 1990 534. The public does not expect fiscal deficits to be inflationary in Switzerland. Instead it will (rationally) anticipate monetary policy moves that will act to keep inflation at its target level.

41 In their cross-country comparison including eight countries Demopoulos/Katsimbris/Miller (1987 1047) find "that the move to monetary targeting has seemingly reduced the degree of linkage of monetary policy to government deficits."

for the cyclical component of the federal deficit regressed on monetary base growth for the subperiod from 1973.2 to 1979.4. The significant and positive response of monetary base growth to the actual measures of federal and total deficits and their structural components for this subperiod conflicts with the findings of the previous work. The main difficulty with a comparison is the fact that the sampling periods do not correspond with each other, while results seem to be very sensitive to this.

How do these results relate to the political (in)dependence debate? Following the traditional approach the focus has to be on the sign of the coefficients for the structural component of the federal and total deficit. The M1 model (equations 11 and 12) does not yield any information on this question. In the monetary base model (equations 6 and 7) the significant positive coefficient for this variable for the subperiod between 1973.2 and 1979.4 implies accomodating behavior. The SNB seems to monetize part of the structural component of the federal and total deficit, a behavior that is not consistent with political independence. Following the argument presented in section 2 the significant negative coefficient on the cyclical component of the federal deficit for this same subperiod suggests offsetting behavior and is consistent with political independence. Therefore, no clear picture emerges with respect to the (in)dependence debate. Moreover, these interpretations cannot directly be inferred. (See Demopoulos/Katsimbris/Miller 1987 1045) A negative relationship between deficits and money growth need not indicate offsetting behavior and independence. It can be consistent with other arguments as well. A combination of easy fiscal policy and tight monetary policy for instance could be part of the political strategy of fiscal authorities, so that a negative relationship could equally well mean political dependence. (See Beck 1984 811 and 814) The relationship found might also depend on the construction of the series. Because of the long and deep recession in the seventies the structural components of the deficit might be cyclical in nature. The positive sign might indicate an offsetting response to weak growth rates of GDP rather than an accomodation of the deficit.

7. Conclusions

This paper reexamines the relationship between various deficit measures and the rate of monetary expansion chosen by the SNB over the period of flexible exchange rates. The focus is on the sign and significance, and on the stability of the coefficients of the fiscal variables. In the regressions with the money supply M1 as dependent variable no response to deficit variables can be detected. For the growth rate of the monetary base as dependent variable a significant and positive relationship with the federal and total deficit measures as well as with their structural components is found for the subperiod from 1973.2 to 1979.4. The positive response to the structural component of the federal and total deficit suggests monetization of the deficit and is inconsistent with political independence of the monetary authority. A negative response to the cyclical component of the federal deficit is indicated for the same period. This suggests offsetting behavior and is rather consistent with political independence of the central bank. The response of the monetary base to the federal and total deficits as well as to their cyclical and structural components differs for the two subperiods. The origin of the deficit matters.

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