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Monetary Policy Under Low Interest Rates: The Experience of Switzerland in the late 1970s

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1. Low Interest Rates: Consequences for Monetary Policy

1.1 A Temporary Exchange-Rate Peg?

In the 1990s, most industrialized and many other countries managed to restore price stability after a prolonged period of high inflation. Although a stable price level tends to enhance economic welfare, some economists (e.g., Summers, 1991) have questioned the wisdom of reducing inflation to very low levels. They argue that low rates of inflation may undermine a central bank's ability to counteract adverse shocks to aggregate demand. Such shocks call for a reduction in real interest rates. In the presence of low inflation, nominal interest rates are likely to be low too. Since nominal interest rates normally do not assume negative values, the economy faces a liquidity trap at zero interest rates.[1] Thus, the central bank may be powerless to react to adverse aggregate demand shocks by loosening monetary policy if nominal interest rates are already at low levels.

The current woes of the Japanese economy are often cited as an illustration of the difficulties arising from adverse aggregate demand shocks in an environment of low nominal interest rates. Japan has passed through a long period of stagnation characterized by a stable or even declining price level and short-term nominal interest rates near zero. Numerous analysts have argued that the Bank of Japan's inability to push real interest rates below zero is an important factor impeding the

[1] It is frequently argued that nominal interest rates cannot turn negative. This argument rests on the belief that negative nominal interest rates would prompt investors to substitute currency for interest-bearing assets. Thus, the demand for currency would become perfectly elastic at zero nominal interest rates. However, in the presence of transaction costs (e.g. through losses from robberies, etc.), investors might be prepared to hold cash even at negative interest rates. In

recovery of the Japanese economy. However, in their opinion, the Bank of Japan is not powerless, even in a low-interest-rate environment. They argue that there are various ways in which the Bank of Japan could strengthen the transmission of monetary impulses to the real sector of the economy.

Meltzer (2001), for example, points to the real-balance effect as an additional transmission channel. He offers empirical evidence in support of the view that an increase in the money supply not only affects economic activity by way of a temporary reduction in nominal and real interest rates. Even if nominal interest rates cannot fall because of a zero floor, the increase in the money supply is still effective in stimulating economic activity. As the private sector sees its holdings of liquid assets rise, it is prompted to increase its purchases of goods and services.

In contrast to Meltzer, Svensson (2001) doubts that the real-balance effect matters in practice. He suggests another strategy, based on a temporary exchange rate peg, coupled with a price-level target serving as a permanent anchor for monetary policy. According to Svensson, the Bank of Japan would fix a price-level target path corresponding to a small positive long-run inflation rate. For the current period, the target would exceed the actual price level. To push the price level up to its target path, the Bank of Japan would "jump-start" the economy by lowering the value of the domestic currency against the US dollar. Moreover, after the devaluation, the exchange rate would be pegged temporarily to a crawling objective corresponding to the difference between the domestic inflation target and the higher

Switzerland nominal money market rates briefly became negative early in 1979 (see Sections 1.2 and 3).

US inflation rate. The exchange rate peg would be abandoned again once the price-level target path has been reached.

Svensson employs a rational-expectations model, in which uncovered interest parity holds, save for an exogenous foreign-exchange risk premium. If the Japanese currency were pegged to the US dollar, the interest parity condition implies that Japanese interest rates would rise towards US levels so long as the peg is maintained.[2] Despite the increase in nominal rates, real interest rates would fall temporarily. Since the Bank of Japan would endeavor to push the price level up to its target path, inflation expectations, in the short run, would rise more than nominal rates. The temporary drop in real interest rates, together with the initial devaluation of the domestic currency, would serve to stimulate Japanese economic activity. Svensson believes that his proposal would offer "a foolproof way of escaping from a liquidity trap."

Of course, only an experiment could tell whether the proposal is as "foolproof" as Svensson takes it to be. To make the proposal work, both the geniuses and fools among central bankers would have to tackle at least four difficult problems. First, they would have to determine the size of the initial currency devaluation. It would have to be sufficiently large to pull the economy out of the liquidity trap, but still small enough to prevent the price level from rising above the target path. Second, the crawling peg would have to be credible. If market participants were not convinced about the central bank's ability to defend the crawling peg, a speculative attack on the domestic currency might ensue. Third,

[2] According to Svensson's model, Japanese nominal interest rates would remain below their US counterparts, with the difference equaling the rate of appreciation in the Japanese currency

due to long policy lags, the central bank would have to monitor carefully the effects of the crawling peg. It would have to take timely corrective action if the crawling peg, contrary to expectations, were to elicit too much or too little monetary ease. Should pegging the exchange rate impinge on the transmission process along the lines suggested by Svensson, the central bank might face an additional difficulty: The "perverse" response of nominal interest rates to the relaxation of monetary policy might complicate the central bank's task of monitoring the effects of the crawling peg. Fourth, the central bank would need an exit strategy for abandoning the crawling peg once the economy has been pulled out of the doldrums.

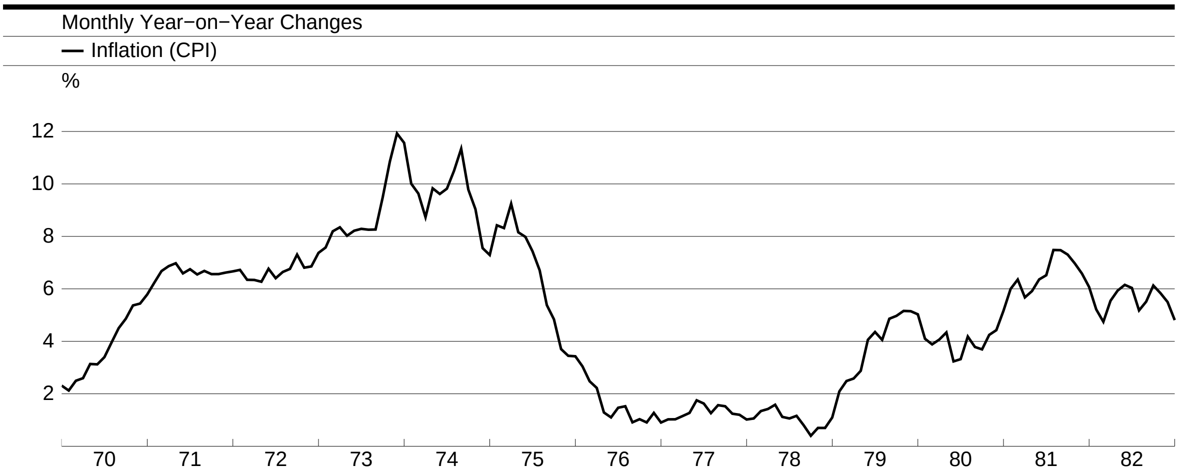
1.2 Swiss Experience with a Temporary Peg

It is hard to predict how well the authorities would handle these problems in practice if Svensson's proposal were to be realized. Swiss experience of the late 1970s might shed light on the difficulties arising from a temporary exchange rate peg. As can be seen from fig. 1, Swiss inflation rose to over 10 percent in the first half of the 1970s. While the upsurge in the domestic price level was triggered by a worldwide increase in inflation resulting from the overly expansionary US monetary policies in connection with the Vietnam War, it was exacerbated by adverse monetary developments in Switzerland. Fig. 2 indicates that the Swiss monetary aggregates grew explosively in 1971 and thus contributed to fueling inflation. This enormous increase in the monetary aggregates reflected the Swiss authorities' obligation to defend the then still fixed exchange rate for the domestic currency, which was

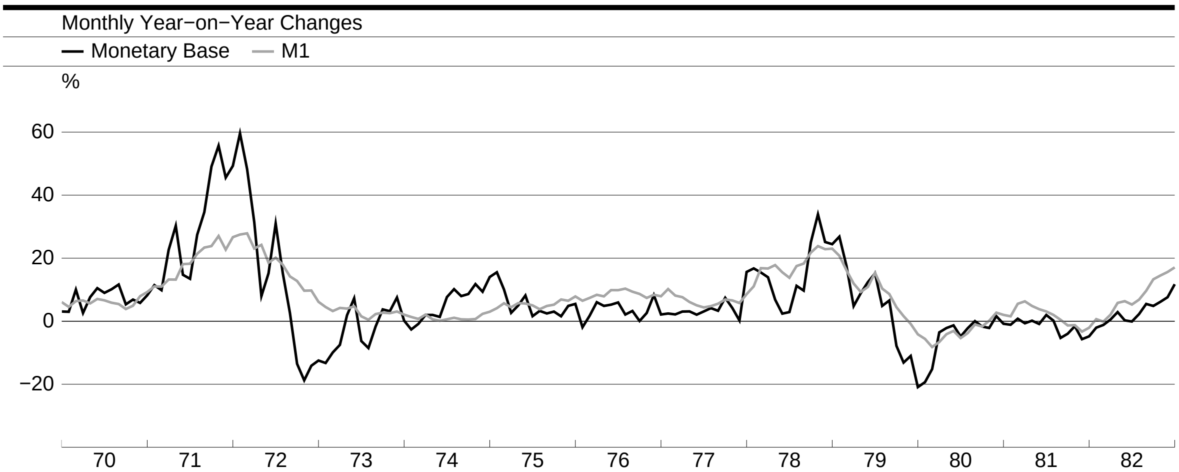
allowed by the authorities. Presumably, this would apply only to the interest rates on assets maturing within the period during which the peg is expected to be maintained.

subject to strong speculative upward pressure.[3] At the beginning of 1973, Swiss authorities were forced to abandon the fixed-exchange-rate system. Without any obligation to intervene on the foreign exchange market, the SNB was free to pursue domestic policy objectives. It decided to aim monetary policy mainly at achieving price stability. To this end, the SNB - in December 1975 - began to set targets for annual growth in the money stock M1.

Consumer Price Inflation Figure 1

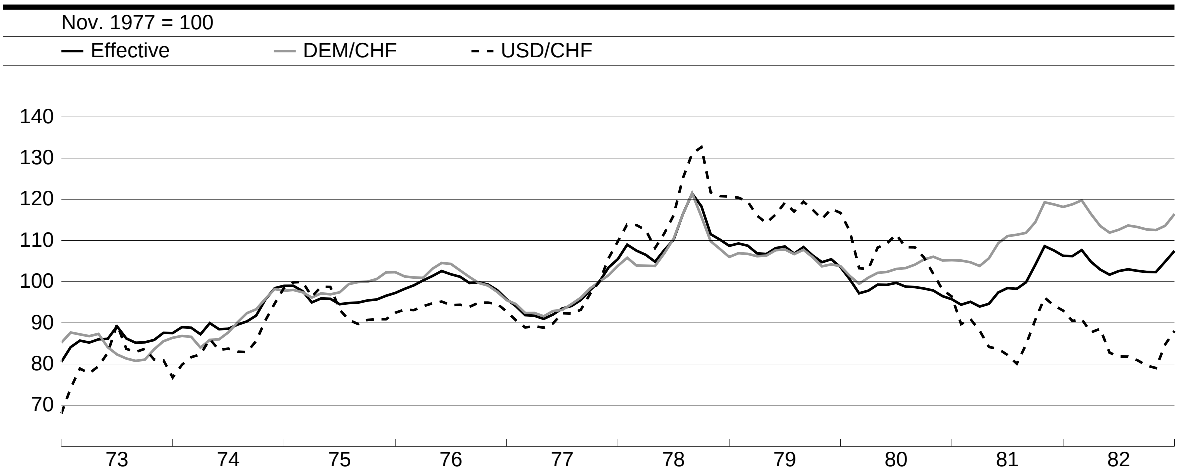


Growth in Monetary Base and Money Stock M1 Figure 2

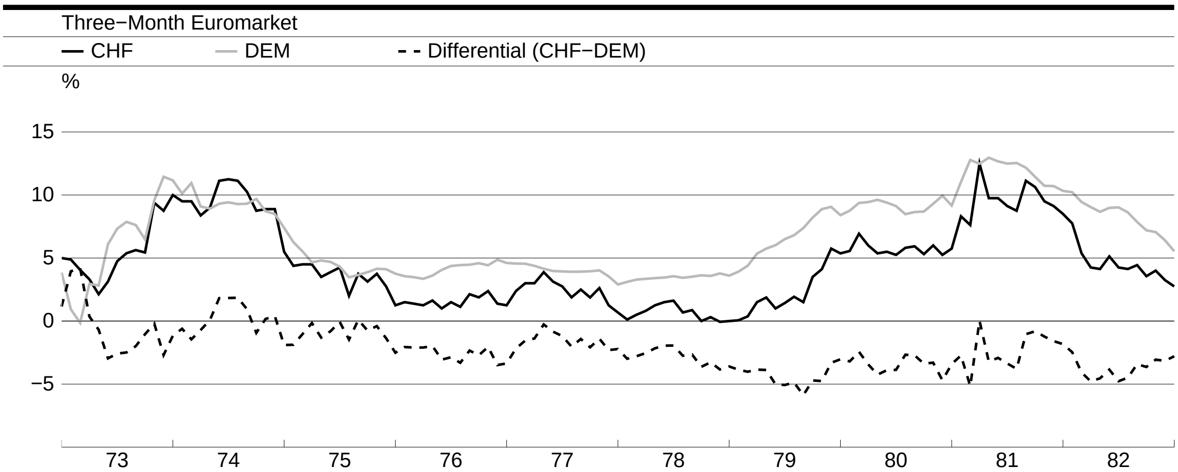


3 The Swiss franc was revalued twice in 1971, the second time in the context of the Smithsonian Agreement. The two revaluations calmed the foreign exchange market only temporarily.

Real Exchange Rate of Swiss Franc Figure 3



Money Market Rates Figure 4



The SNB's desire to restore price stability came to fruition. Inflation fell quickly and reached a level of roughly 1 percent in the middle of 1976 (fig. 1). The SNB's anti-inflationary stance was supported by a sharp upsurge in the exchange rate of the Swiss franc, both in nominal and real terms (fig. 3). Even though exchange rate developments contributed to lowering the inflation rate, the SNB became increasingly concerned about the size and speed of the upsurge in the Swiss franc. To moderate this upsurge, the SNB repeatedly intervened on the foreign exchange market and Swiss authorities tightened various restrictions on inflows of foreign capital that they had inherited from the fixed-exchange-rate period. However, these measures appeared to have little effect on the exchange rate so long as the SNB was determined to stick to its monetary targets.[4]

In 1978 the upsurge in the real exchange rate reached proportions (fig. 3) that raised the specter of a sharp slump in Swiss economic activity. The SNB could no longer rule out the possibility of the Swiss economy plunging into a recession with deflationary consequences. However, as shown by fig. 4, short-term interest rates had already fallen to very low levels. The SNB could not respond to the deflationary shock simply by relaxing monetary policy as there was little scope for a further decline in short-term interest rates. Nevertheless, considering the catastrophic consequences of the high real exchange rate, the SNB had to act.[5] At the beginning of October 1978, it decided to switch to a temporary exchange rate target by setting a floor under the Swiss-franc price of the Deutsche mark. The floor was placed above the level of the exchange rate then prevailing.[6] In this manner, the SNB hoped to stabilize exchange rate expectations (Schiltknecht, 1989, p. 252).

To defend the exchange rate peg, the SNB was compelled to purchase foreign exchange on a large scale. This prompted a huge increase in the monetary base and the money stock M1 (fig. 2). Moreover, short-term interest rates, at least on the interbank market, fell to zero and even turned slightly negative early in 1979

4 See Schiltknecht (1983; 1989) and SNB (1982, pp. 230-235) for more detailed discussions of these measures. Late in 1977, the SNB bought heavily foreign exchange against domestic money in an effort to curb the upsurge in the Swiss franc. As a result, the monetary aggregates expanded strongly. In the spring of 1978, the SNB tightened policy again in order to keep money growth in line with the target. No sooner had the SNB tightened policy than the exchange rate resumed its upward course (figs. 2 and 3).

5 The Swiss federal government considered introducing a two-tier exchange rate system, under which it would have fixed the rate on current transactions, and allowed the rate on financial transactions to float.

6 The Swiss-franc price of 100 Deutsche mark had dropped to a low of 75. The SNB stated that it would keep the exchange rate substantially above 80 (SNB, 1979, pp. 9-10).

(fig. 4). Thus, contrary to the predictions of Svensson's model, short-term interest rates did not rise after the policy change. The liquidity effect of the expansionary monetary policy still obtained, despite the change in the monetary regime. As a result of the switch to a temporary exchange rate target, the upward pressure on the Swiss franc quickly subsided. As may be seen from fig. 3, the policy switch was followed by a marked decline in the Swiss-franc exchange rate, removing the threat of deflation from the Swiss economy. The SNB (1979, pp. 9-10) was aware of the risk that the policy switch might fuel inflation.

Of course, the SNB hoped that it would be able to stabilize the exchange rate without jeopardizing price stability. Even though it did not fix a monetary target at the end of 1978, the following year it made every effort to eliminate the monetary overhang created by the need to defend the peg. Moreover, at the end of 1979, the SNB returned to monetary targeting. However, in contrast to the practice followed before 1978, the SNB began to fix annual growth targets for the monetary base, rather than the aggregate M1. Nevertheless, the SNB failed to preserve price stability. In due course, inflation rose again, reaching a peak of over 7 percent in 1981 (fig. 1).

The SNB's inability to preserve price stability led several analysts to conclude that the switch to a temporary exchange-rate target had been mistaken.[7] In their view, central banks straying from the path of virtue sooner or later would be punished by a jump in the inflation rate. If these analysts were right, one might well doubt whether Svensson's proposal would work in practice. It should be noted that

[7] For example, Fritz Leutwiler, President of the SNB from 1974 to 1985, later expressed this view (Schiltknecht, 1989, p. 253).

the SNB's temporary peg differed from Svensson's proposal in some respects. While the SNB's problem was to counteract an incipient deflation threat, Svensson has in mind an economy already plagued by declining prices. Moreover, contrary to Svensson's recommendation, the SNB did not fix an inflation target, nor did it rely on formal inflation forecasts to set monetary policy. We doubt that fixing an inflation target would have changed much since the public had confidence in the SNB's determination to keep inflation low. However, as we will show later, the absence of formal inflation forecasts did pose problems. Thus, despite these differences, Swiss experience should shed some light on the practicability of Svensson's proposal.

In the following, we examine the reasons for the unsatisfactory performance of the Swiss temporary peg. In particular, we attempt to answer the question of whether the temporary peg was inherently flawed or whether it was fine in principle but handled badly by the SNB. In Section 2, we analyze possible reasons for the unsatisfactory performance of the temporary peg. In Sections 3 and 4, we investigate econometrically the effects of the SNB's measures. We ask whether the liquidity effect of the expansionary monetary policy could still be observed under the temporary peg and how the change in the monetary regime affected the inflation rate and other variables. We also explore the question of whether the SNB would have been able to preserve price stability had it handled the temporary peg in a different manner.

2. Possible Reasons for the Rise in Inflation in the Early 1980s

2.1 Tardy Elimination of the Monetary Overhang?

In an analysis of the temporary peg, Schiltknecht (1989), then the SNB's chief economist, argued that Swiss policy makers had been too tardy in eliminating the monetary overhang generated at the end of 1978. In his view, fixing the exchange rate temporarily was entirely appropriate. However, the SNB should have returned to monetary targeting earlier than at the end of 1979. Had it stuck to past practice and fixed a money stock target for 1979, it would have been prompted to reduce the monetary overhang quickly. In this manner, it could have avoided the inflationary consequences of the exchange-rate peg.

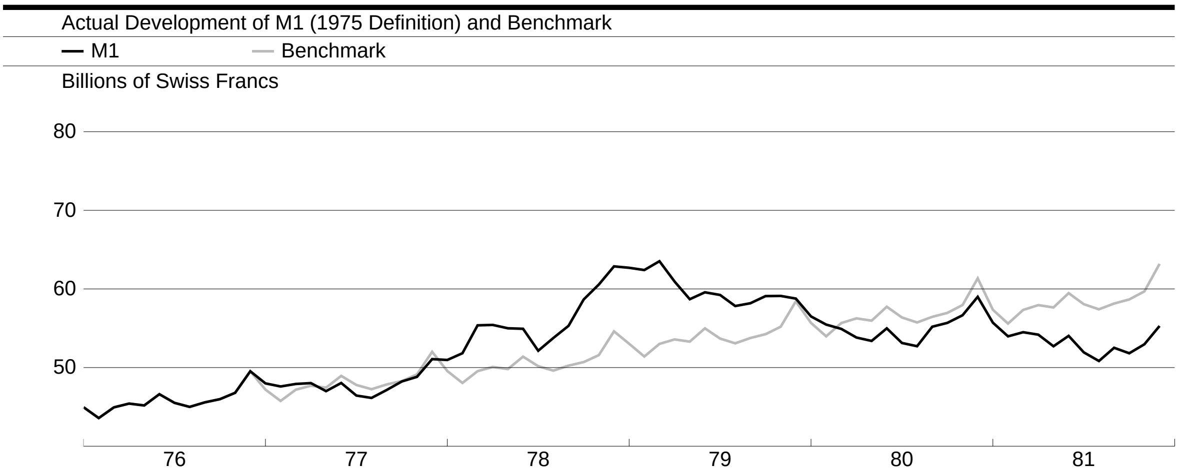
It is true that the SNB lacked a clearly-defined strategy for exiting the exchange-rate peg. Nevertheless, we doubt that the SNB would have been wise in setting a monetary target for 1979. Returning to monetary targeting only a few months after the shift to the temporary peg might have rekindled the capital flight into Swiss francs. Although the SNB probably had no choice but to maintain the peg for some time, it did make every effort to reduce the monetary overhang once the exchange rate had weakened sufficiently. Moreover, Swiss authorities dismantled most of the restrictions on capital imports.[8] When the SNB resumed monetary targeting at the end of 1979,[9] it assumed that it had removed the monetary

[8] By the summer of 1980, virtually all the restrictions had been abolished (SNB, 1980, pp. 49-52, 60-63); 1981, pp. 42-47).

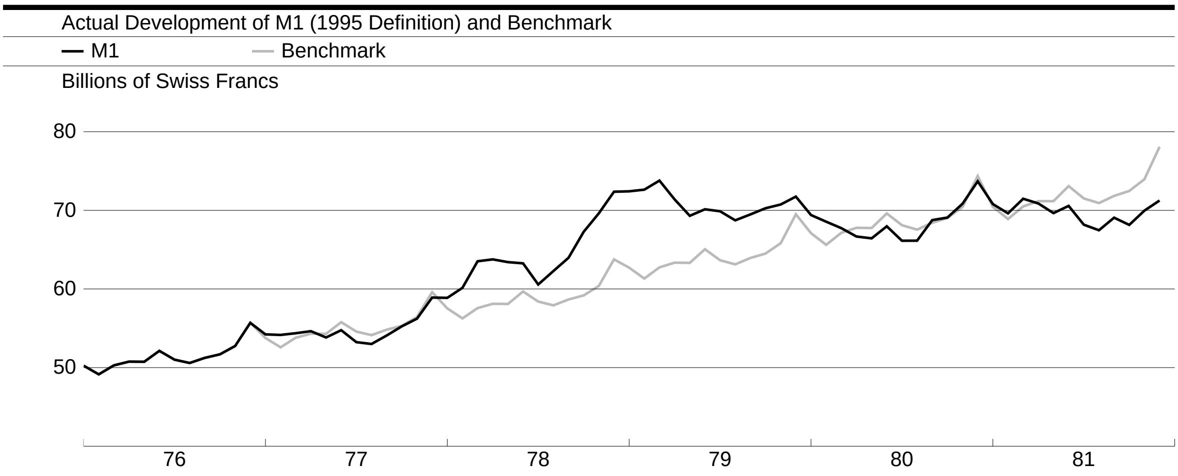
[9] The return to monetary targeting was facilitated by the fact that both the Federal Reserve System and the Deutsche Bundesbank adopted a restrictive monetary policy towards the end of 1979. See SNB (1980, pp. 8-13) for a description of Swiss monetary policy in 1979.

overhang created the year before.[10] However, it did not provide evidence to substantiate its assumption. In addition, the absence of a monetary target for 1979 and the shift to a growth target for the monetary base made it difficult for the public to verify the SNB's contention that it had moved back to an expansion path for the money stock consistent with low inflation in the longer run.

Money Stock M1 — Figure 5A

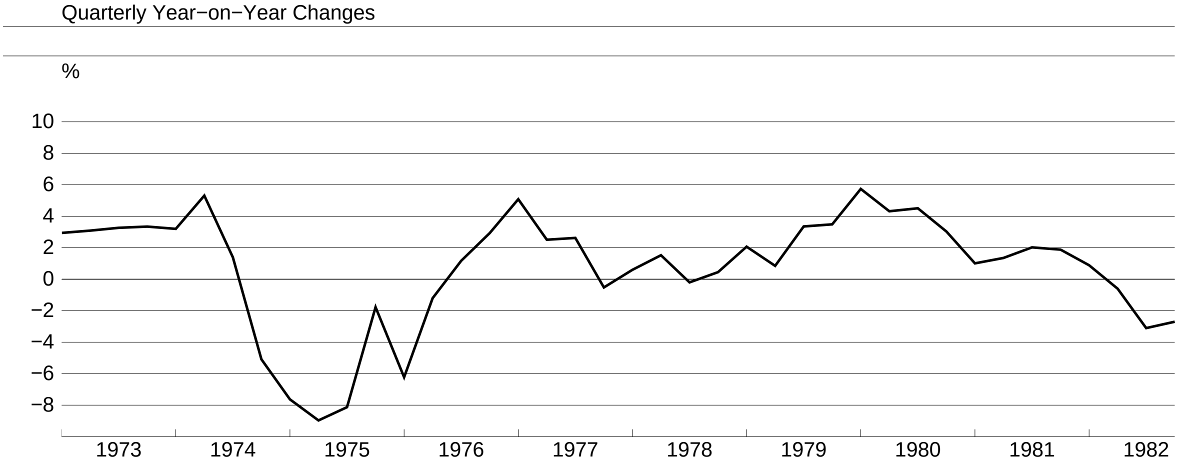


Money Stock M1 — Figure 5B



10 See note 10.

Growth in real GDP Figure 6



To judge Schiltknecht's assertion, we derive a benchmark expansion path for the money stock M1, which may be used for assessing the SNB's policy performance after the switch to the temporary exchange-rate peg. The benchmark, as shown in fig. 5A, traces the evolution of M1 that would likely have obtained in the absence of the 1978 shock. We employ the actual monthly values of M1 in 1976 as starting points for our analysis because the real exchange rate still appeared to be in line with fundamentals at that time. Since the definition of M1 was adjusted in 1995, we use the data for this aggregate that were available to the SNB in the late 1970s.[11] For both 1977 and 1978, the SNB fixed relatively generous targets, stipulating growth in M1 of 5 percent per year. These targets reflected the SNB's desire to reduce inflation gradually. The SNB did not try to achieve price stability at once, but for the time being was willing to tolerate a trend inflation rate of about 3 percent.[12] Moreover, these targets were designed to accommodate growth in potential output of 2 percent. In announcing the target for 1977, the SNB (1976, p. 3) emphasized that - though it intended to keep inflation low - it did not want to

[11] The data shown in fig. 5A are based on the definition of M1 introduced in 1975. In 1995, the coverage of M1 was extended to include new types of transactions accounts (Fluri, 1995).

jeopardize the recovery of the Swiss economy and to reinforce the upward pressure on the Swiss franc. The same considerations applied to the target for 1978. By increasing the actual monthly values of M1 for 1976 by 5 percent each, we obtain the corresponding monthly benchmark levels for 1977. The monthly benchmark levels for 1978 are determined analogously by adding 5 percent to the corresponding benchmark levels for 1977.[13]

It is difficult to calculate benchmark values for 1979 as no monetary target was set for that year. However, unpublished internal documents prepared by the SNB's staff economists suggest that in normal circumstances, an expansion in the money stock M1 of 7 percent might have been in keeping with the SNB's desire to reduce the inflation trend gradually. The staff raised the "target" for 1979 by 2 percentage points in order to accommodate the first-round effects of the second oil price shock. As indicated by fig. 1, the rise in the oil price caused the inflation rate to peak temporarily in 1979. The switch to a new target aggregate at the end of 1979 complicates the derivation of benchmark values for 1980 and 1981. However, despite the SNB's new focus on the monetary base, the staff continued to monitor the development of M1 because it derived the monetary-base target from an implicit objective for M1, with the help of a time-series model designed to forecast the money multiplier (Büttler, et. al., 1979). At the end of 1980, the staff expressed the

12 Due to the strong appreciation of the Swiss franc, recorded inflation was below trend between 1976 and 1978.

13 This procedure is used because the SNB's monetary targets - until the end of the 1980s - normally pertained to the annual average of the monthly year-on-year rates of change in the respective aggregates. The only exception was the target for the monetary base fixed at the end of 1979, which defined the average increase over the level recorded in the middle of November 1979 (SNB, 1981, p. 23). The November 1979 value of the monetary base was chosen as a starting point because, as indicated earlier, the SNB believed that the monetary overhang had melted away by then. Note that the SNB did not use seasonally adjusted values for M1 because

view that the time had arrived to reduce the implicit objective for M1 from 5 to 3 percent. Such a reduction would permit the SNB, at last, to lower trend inflation to a level consistent with price stability.[14] Considering the SNB staff's views, we assume that in normal circumstances the SNB would have kept M1 growth at 5 percent in 1980. For 1981 we employ the stated rate of 3 percent to derive the monthly benchmark values displayed in fig. 5A.[15]

The benchmark may be compared with the actual evolution of M1 in order to determine the speed at which the SNB eliminated the monetary overhang. Fig. 5A largely confirms the SNB's views. The SNB strove to remove the overhang quickly when the turmoil on the foreign exchange market had calmed down. Obviously, by the end of 1979, the overhang had completely vanished. Interestingly, the aggregate M1 was back on the benchmark line about a year before the inflation rate set out to shoot up to a level of over 7 percent. As may be seen from fig. 1, the increase in the inflation rate, triggered by the second oil price shock of 1979, was reversed again to some extent the following year. In the summer of 1980 the inflation rate returned to a range of 3 to 4 percent. This seems to confirm the view expressed above that the SNB's monetary targets served to keep trend inflation in the neighborhood of 3 percent. Since the SNB eliminated the overhang in a timely manner, it is hard to explain the sharp increase in inflation rate in 1981.

calculating year-on-year growth rates served as a form of seasonal adjustment. For this reason, the data in Figs. 5A and 5B are not seasonally adjusted.

[14] The SNB has always argued that due to measurement errors in the price index, price stability implies a small positive inflation rate.

[15] Although a reduction in M1 growth was deemed desirable, the SNB left the published monetary-base target for 1981 at 4 percent, i.e., at the same level the year before. The SNB (1981, p. 9) pointed out that the target was slightly higher than the rate it intended to achieve in the medium and long run. The following year, it reduced the monetary-base target to 3 percent (SNB, 1982, p. 8). See also Rich (2000).

We obtain roughly the same result if we use the data for M1 based on the 1995 revision. In this case, however, the benchmark line must also be adjusted because the revision increased the trend growth in M1 by about 2 percentage points (Fluri, 1995, chart 3). For this reason, the SNB’s desired growth rates for M1, listed above, are augmented by 2 percentage points each. This yields the benchmark line displayed in fig. 5B. The analysis based on the revised data also suggests that the SNB eliminated the monetary overhang completely in the course of 1979. Thus, we must search for other reasons for the surge in inflation in 1981.

2.2 The SNB’s Approach to Monetary Targeting Flawed?

The policy course the SNB followed in 1981 points to another cause of the renewed jump in inflation. As revealed by fig. 5, in that year, the aggregate M1 did not stay near the benchmark line but dropped below it substantially. The 1981 deviation in M1 from the benchmark line mirrored an important flaw in the SNB’s approach to monetary targeting.

While the virtues of monetary targets were uncontested, there was some disagreement within the SNB about how the monetary targeting strategy should be implemented. The SNB’s Governing Board, on the whole, believed that in normal circumstances, the best monetary policy strategy was to aim at steady expansion in the monetary aggregates. For this reason, at the end of 1979, the SNB (1980, p. 9) undertook to place the monetary base on a steady expansion path. In emphasizing steady expansion *(Verstetigung des Wachstums)* in the money supply, the SNB followed the advice of leading monetarists, who proposed this strategy as a remedy for destabilizing behavior on the part of central banks.

However, it was not clear whether steady expansion in the money supply constituted an optimum policy strategy. Some SNB officials pleaded for a flexible approach to monetary targeting. In their view, the central bank of a small open economy such as Switzerland should be responsive to destabilizing shocks coming from abroad.[16] As a matter of fact, steady expansion in the money supply frequently did not suffice to keep inflation in check, even in the absence of such major shocks as had struck in 1978. The strategy of steady monetary expansion failed to perform as well as expected because of the high sensitivity of Swiss money demand to changes in interest rates. The high interest sensitivity implied that a strategy of steady monetary expansion was not powerful enough to stabilize cyclical fluctuations in the inflation rate. As indicated by fig. 6, the strong real appreciation of the Swiss franc in 1977 and 1978 arrested temporarily the cyclical expansion in domestic economic activity that had started in 1975. Thanks to the switch to a temporary exchange-rate peg, growth in real GDP resumed its upward course in 1979. As the economy continued to grow, the SNB assumed that its strategy of steady monetary expansion would quell the inflationary impulses emanating from the cyclical rise in economic activity. Provided the SNB kept a tight rein on the expansion in the money supply, the rise in money demand caused by the cyclical upswing would trigger an increase in interest rates sufficiently strong to avert a resurgence of inflation. However, the strategy of steady monetary expansion did not produce the expected results. Due to the high interest sensitivity of money demand, interest rates failed to rise by as much as was required to keep inflation under control.

[16] For example, Schiltknecht (1976; 1979) argued that the SNB should keep annual growth in M1

In an effort to counter the inflationary pressures emerging in 1981, the SNB pushed up short-term interest rates by switching to a tighter course than it had envisaged upon setting its monetary target. As a result, it undershot its monetary target by a substantial margin.[17] The SNB's policy shift also explains the sharp drop in the money stock M1 below the benchmark line. However, the SNB's efforts to push up interest rates probably came too late to impinge significantly on inflation. It clearly did not suffice to bring M1 back to the benchmark line in 1979. Instead, the SNB should have tightened monetary policy further by pushing M1 below the benchmark line in 1980 already. In this way, the SNB could have speeded up the rise in interest rates and strengthened the stabilizing powers of its monetary policy.

Consequently, it is unlikely that the switch to the temporary exchange-rate peg and the attendant monetary expansion, by itself, accounted for the resurgence of inflation in the early 1980s. Another reason was the SNB's emphasis on steady growth in the money supply. Due to high interest sensitivity of money demand, the strategy of steady monetary expansion did not compel the SNB to act in a sufficiently pre-emptive manner when a cyclical expansion (or contraction) threatened to disturb price stability.[18]

The failure to grasp fully the implications of interest-sensitive money demand also bore on the SNB's analysis of the 1978 shock. The SNB's strategy of steady

within 2 and 7 percent (or 3 and 7 percent) in order to maintain a low trend rate of inflation. However, the SNB should vary money growth within this range in response to external shocks.

17 The growth in the monetary base had been below target already in 1980. There was also another reason for the deviation in base-money growth from the target: The removal of the restrictions on capital imports led to an unexpected downward shift in demand for large denomination bank notes that foreigners had held to circumvent these restrictions (Ettlin, 1989).

18 Peytrignet (1996, pp. 252-255) and Rich (1989; 2000) discuss the implications of a high interest sensitivity of money demand in greater detail and they conclude that the SNB's monetary

expansion in the money supply not only weakened its ability to counteract cyclical shocks to aggregate demand. It also reinforced the effects on domestic economic activity of portfolio shifts into Swiss francs. As investors strove to acquire Swiss-franc denominated assets, they pushed up the exchange rate of the Swiss franc and drove down domestic interest rates. For this reason, the uncovered interest rate differential between Switzerland and Germany widened considerably in 1978 (fig. 4). The fall in domestic interest rates caused money demand to rise. As long as the SNB refused to deviate from the monetary target, the additional money demand could be satisfied only by a rise in the real supply, induced by a decline in the domestic price level. The deflationary effect of the portfolio shock was larger, the stronger the reaction of money demand to changes in interest rates.[19]

The SNB did not consider the consequence of the interest sensitivity of money demand for the transmission of portfolio shocks to the domestic economy. Instead, it focused on possible direct effects of exchange-rate expectations on the demand for M1. It argued that expectations of an appreciation in the Swiss franc prompted investors to substitute domestic for foreign currency (SNB, 1981, pp. 7-8; Schiltknecht, 1989).[20] It also justified the change in its target variable at the end of 1979 by asserting that the demand for M1 was more susceptible to exchange-rate expectations than the demand for base money. However, subsequent (unpublished) research by the SNB failed to detect strong effects of exchange-rate

targets, though flawed as a cyclical stabilizer, were effective in keeping the inflation trend at a low level.

[19] The appreciation of the Swiss franc not only lowered the domestic price level, but could also lead to a fall in domestic output, offsetting to some extent the stimulating effect on money demand of the drop in interest rates. See Rich (1997) for a theoretical analysis of the effects of portfolio shocks within the framework of a rational-expectations model.

expectations on demand for M1[21]. Nevertheless, the SNB was well advised to alter its target variable because demand for M1 was more responsive to variations in interest rates than demand for base money.

Although the SNB reacted appropriately to the portfolio shock of 1978, its focus on direct currency substitution diverted its attention away from the more important problems arising from the interest sensitivity of money demand. The SNB might have been more successful in controlling inflation hat it been less concerned about possible effects of exchange-rate expectations on money demand and more willing to rely on inflation forecasts in order to decide how to react to the portfolio shock. Since there was little evidence of exchange-rate expectations affecting money demand, the estimation errors detected in demand equations for M1 did not provide the information required to decide how far the SNB should deviate from and how quickly it should return to the benchmark line in fig. 5. This information could be extracted only from forecasting the effects on inflation of the portfolio shock and the SNB's reaction to this shock. To be fair to the policy makers in charge of the SNB at that time, we must emphasize that it would have been extremely difficult to produce reliable inflation forecasts. Since Switzerland had just switched to a floating exchange rate, the SNB was in the dark as to how monetary policy impinged on the business cycle under the new exchange rate regime.[22]

20 Econometric research by the SNB pointed to an unexpected upward shift in the demand for M1 in 1978. However, the estimation error recorded for 1978 was not particularly large as compared with those observed for earlier periods.

21 Schiltknecht (1989, p. 254) cites the instabilities in demand for M1 that Belongia (1988) detected for the early 1980s. In his view, Belongia's study points to a link between demand for M1 and exchange-rate expectations. However, these instabilities vanished after the revision of the aggregate M1 in 1995 (see Fluri, 1995, charts 4 and 5).

22 The failure to respond appropriately to cyclical shocks in economic activity (again in the late 1980s) was an important reason why the SNB switched to multi-year monetary targeting at the end of 1990 and abandoned monetary targeting altogether at the end of 1999 (Rich, 2000).

In the following we ask whether the SNB could have averted the jump in inflation in 1981 if it had placed less faith in its strategy of steady monetary expansion and shown more determination to act pre-emptively. We begin by checking for the existence of a liquidity effect under the temporary exchange rate peg.

3. The Liquidity Effect in Switzerland 1978-1983: Evidence from Daily Data

In this section we report some empirical results on the liquidity effect of Swiss monetary policy during the years 1978-83. To this end, we estimate a standard VAR model using daily data for three variables, i.e., the log of the monetary base, the one-month Euro interest rate for Swiss francs and the log of the SFr/DM exchange rate. In addition, two dummy variables are included to capture the regular end-of-month and end-of-quarter increases in the monetary base. This framework allows us to test for possible shifts in the dynamics of three key monetary policy variables, due to the changes in the monetary regime during the period 1977-1983.

We begin by considering a VAR with lag length of 3 working days for the entire 1977 to 1983 period[23] and by testing for shifts in the dynamics of the variables. For this reason, we use the sequential multiple break procedure with unknown break points developed recently by Bai and Perron (1998). This approach sequentially determines the break point according to the maximum F-statistic for the

[23] This rather short lag length turned out to be optimal according to the Schwarz criterion. A slightly larger lag length (4) is recommended by the Akaike criterion, but the results are essentially unchanged by the adoption of this larger lag length.

Chow test applied to all possible break points[24]. In a first step (l=0), it identifies the first break point and splits the sample into two parts. In a second step (l=1), the same approach is applied to the two subsamples, and the break point with the larger F-statistic of the two maxima is adopted as a second break point. For the two new subsamples obtained, we again apply the same procedure as in the previous step (l=2). This process is repeated until the maximum number of breaks considered is reached. The critical values of the asymptotic distribution for the test of l+1 against the alternative l breaks were tabulated by Bai and Perron. These critical values are much larger than the corresponding values for a Chow test with known break points and depend on the sequential step index l, besides the number of regression coefficients. We selected a maximum of four break points and a minimum distance of 265 days between two breaks.

The results of the Bai Peron test are reported in table 1 for all the three VAR(3) equations. The variables are denoted by LMBCH (log monetary base), ISF1W (one-month interest rate) and LSFDM (log Swiss franc/DM exchange rate). For all the equations we find at least one break that is statistically significant at the 1 percent level. For the monetary base there are breaks in January 1978, January 1980 and November 1982 (significant at the 5 percent level). The two dominant breaks correspond nicely to the two years in which the SNB strongly deviated from or did not set a monetary target. The interest-rate equation features only one statistically significant break, i.e. in June 1979, when the short-term interest rate started to rise strongly from the low levels that had prevailed since 1977. For the

[24] To be precise it should be mentioned that the test statistic is calculated and tabulated as the corresponding chi square statistics, namely the number of regression coefficients tested times the usual F-statistic.

exchange rate we detect two breaks (September 1978 and November 1979), which broadly coincide with the beginning and the end of the SNB's exchange rate targeting period.

Considering these results, we report impulse response estimates for two periods without breaks in any of the VAR equations. These periods extend from the end of September 1978 to the middle of June 1979 and from the end of November 1982 to the end of December 1983, and are characterized by strongly different monetary regimes: near-zero interest rates and an exchange rate peg in the former period, in contrast to interest rates between 3 and 5 percent and a base-money target in the latter. The impulse response analysis is based on the standard Cholesky decomposition, with the ordering of the variables indicated above to identify structural shocks. The shock in the monetary base (interpreted as a money supply shock) has contemporaneous effects on the interest rate and the exchange rate, whereas the interest rate shock (a money demand shock) influences only the exchange rate. The shock in the exchange rate (a portfolio shock) has no contemporaneous impact on the other two variables. It should be mentioned that the recursive ordering of the contemporaneous effects is not of major importance for the impulse response estimates as the contemporaneous correlations of the reduced-form VAR residuals are close to zero with the high-frequency data used.

Fig. 7 reports the impulse-response estimates (with two standard error bands) for the low-interest-rate subsample 1978/79. First of all, we note a significant liquidity effect of a money supply shock. An unexpected one-percent increase of the monetary base leads to an initial decrease in the short-term interest rate by 5 basis points. The dynamic effect of such a shock on the exchange has the expected positive sign but the impulse response estimates are not very precise. This is not surprising in view of the high exchange-rate volatility during the period under consideration. However, the contemporaneous impact of an unexpected increase in the interest rate on the exchange rate is perverse since LSFDM rises. In interpreting this result, we should recognize that the monetary base impulse responses point to an accommodating monetary-policy reaction to interest- and exchange-rate shocks. This may explain the positive response of the exchange rate to the interest-rate shock.

The impulse response estimates for the subsample 1982/83 are reported in fig. 8. In general, we note that the dynamic interaction of the variables is less precisely estimated than in fig. 7: We only uncover a statistically significant liquidity effect, which is of similar size as in the first subsample, at least for the first couple of days. However, this effect is more persistent in the second than the first subsample, while the persistence of the monetary base displays the opposite pattern. Thus, we conclude that the short-run dynamics of the monetary base, the interest rate and the exchange rate varies only quantitatively but not qualitatively across the two subperiods considered. In particular, we find a significant liquidity effect in both subperiods. Neither the shift to a temporary peg, nor the existence of near-zero interest rates fundamentally altered the response of short-term interest rates to a monetary policy shock. Swiss evidence fails to support Svensson’s contention that in the presence of a temporary peg, a relaxation of monetary policy will raise, rather than lower, nominal short-term interest rates.

Table 1: Bai-Perron Multiple Break Test for VAR Model of Monetary Base, Short term Interest Rate and Exchange Rate, Daily Data 1977-1983

LMBCH	I	ISF1W		LSFDM	
F	Break	F	Break	F	Break
112.74***	80/1/11	51.51***	79/6/18	50.67**	78/9/26
50.63***	78/1/11	31.30	80/11/5	60.97**	79/11/30
39.76**	82/11/23	26.08	82/1/26	26.68	82/6/17
37.66*	81/2/4	14.61	78/6/7	16.53	81/2/27

Critical values are obtained by extrapolating a fitted quadratic logarithmic approximation to the critical values for q=1,2..10, given by Bai/Perron (1998, Table II)

Figure 7: Impulse Response Estimates VAR Model of Monetary Base, Short Term Interest Rate and Exchange Rate, Daily Data 9/26/1978 – 6/18/1979

Monte Carlo S.E.

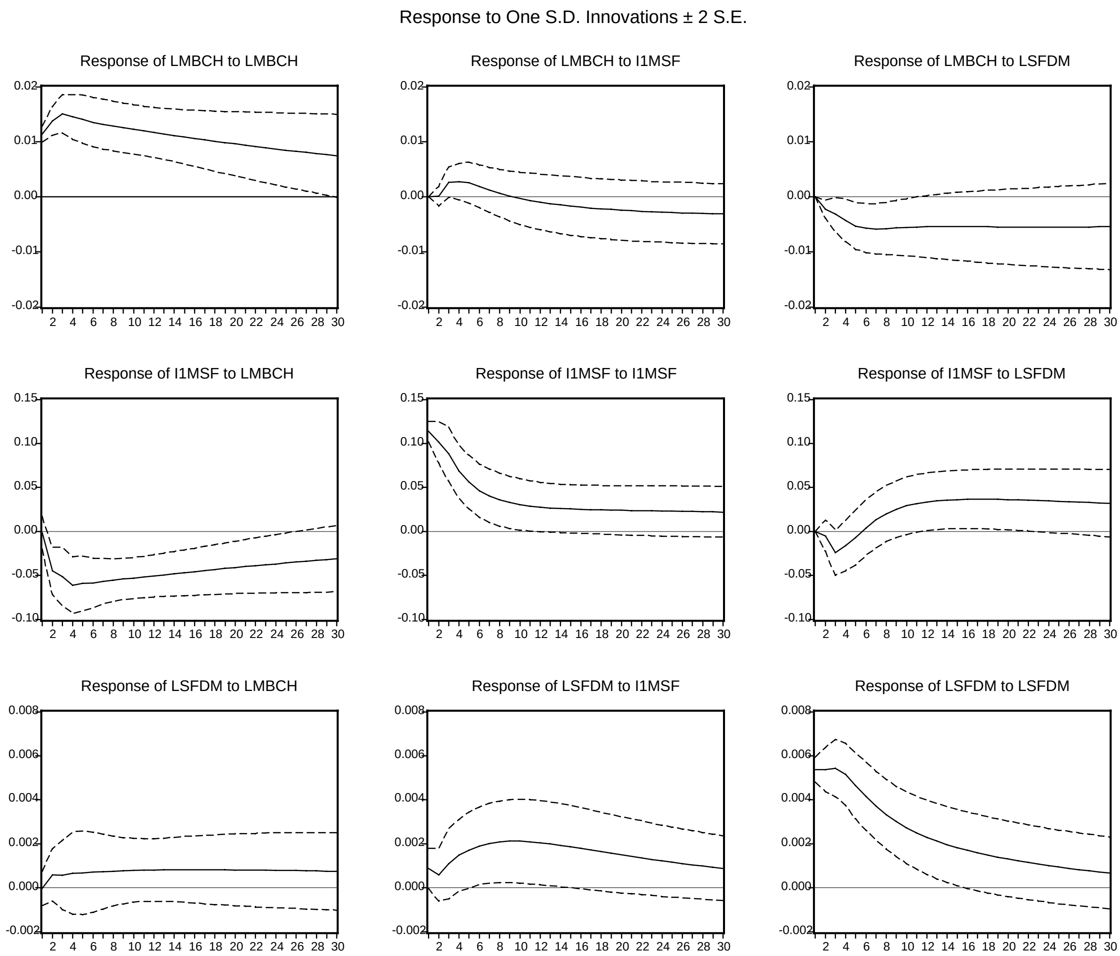
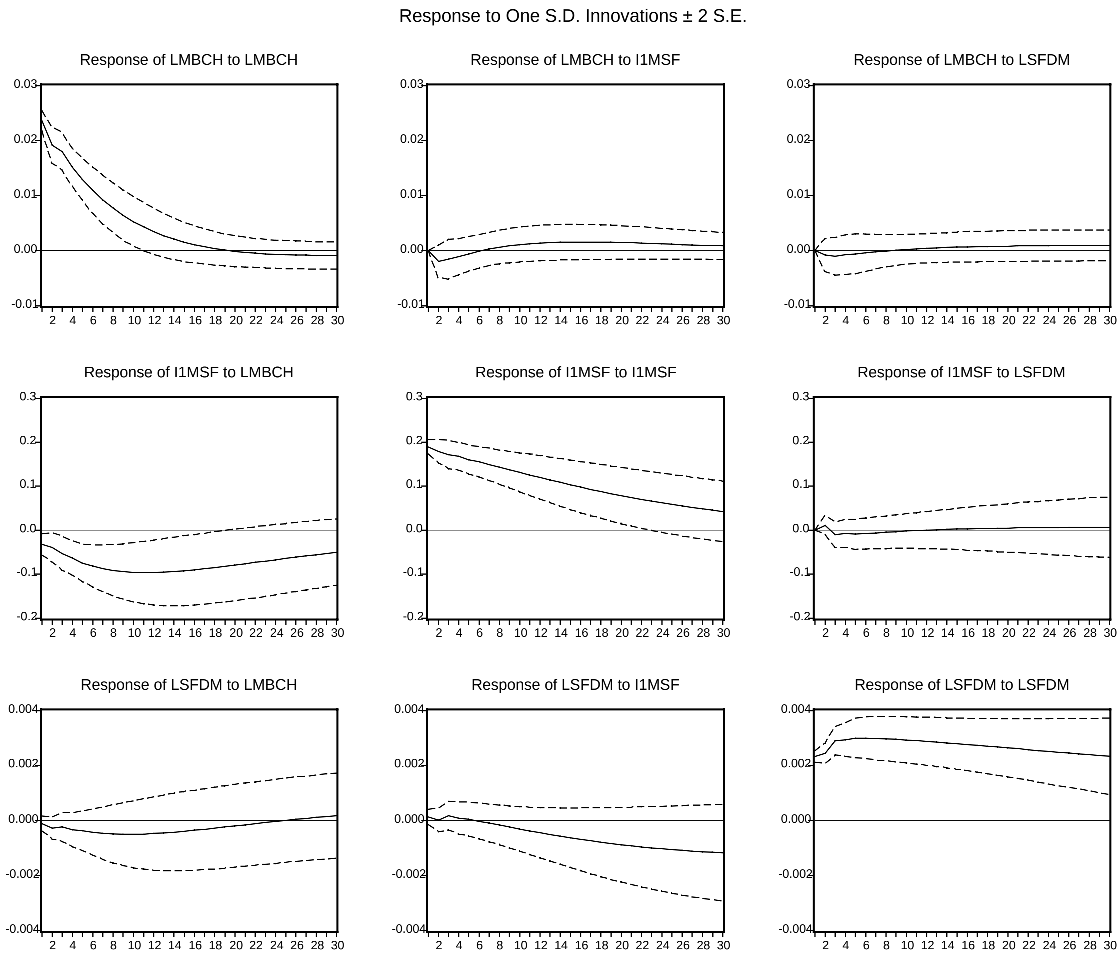


Figure 8: Impulse Response Estimates VAR Model of Monetary Base, Short Term Interest Rate and Exchange Rate, Daily Data 11/23/1982 – 12/30/1983

Monte Carlo S.E.



4. Monetary Policy Based on an Inflation Forecast: A Better Alternative?

In this section we attempt to explore the question of whether an approach based on inflation forecasts would have prompted the SNB to pursue a different policy course in 1979-80. To this end, we use the structural VAR model developed by Kugler and Jordan (2000), in the context the new monetary policy framework introduced by the SNB in December 1999. Under this new framework, the SNB relies on a three-year inflation forecast for setting monetary policy (Rich, 2000). The model is estimated from quarterly data for the period 1974 to 1999. Therefore, it incorporates much more information than was available to the SNB in 1978. Clearly, the SNB could not have employed this model for setting policy in the late 1970s and early 1980s. Nevertheless, the analysis is useful because it sheds light on the policy course that would have been consistent with SNB's goal of preserving price stability.

4.1 A SVAR Analysis of Swiss Monetary Policy

In this section we give a brief account of the framework used for policy analysis.

The VAR model includes a vector of changes in the following four variables:

$$y_t' = (\Delta \log p_t, \Delta \log y_t, \Delta \log m_t, \Delta r_t),$$

where p denotes the consumer price index, y is GDP in 1990 Swiss francs, m the money stock M1 and r the quarterly average of the three-month Swiss-franc Libor rate of interest. In order to keep the model as lean as possible, the exchange rate is excluded from the vector *y.* This may appear inappropriate as Switzerland is clearly a small open economy, with the exchange rate playing an important role. However, the transmission of monetary policy via the exchange rate is indirectly captured by the impulse responses of the VAR model. Explicit inclusion of the exchange rate would be necessary if this variable had influenced SNB behavior in a systematic way and, therefore, were required to identify a monetary policy shock. Although exchange rate considerations played an important role from time to time, notably in 1978/79, this was not true for the bulk of the sample period. Moreover, the standard unit-root and co-integration tests support the first-difference specification adopted in this paper.[25]

The VAR model contains structural short- and long-run restrictions in order to identify a monetary policy shock. First, there are four restrictions essential in the short run. They ensure that the money supply and the money demand shocks do not affect consumer prices and GDP contemporaneously. A sluggish response in prices and output seems to be a reasonable assumption for quarterly macroeconomic data. Second, the money supply and the money demand shocks, as well as the aggregate demand (or IS) shock are assumed to leave real GDP and the interest rate unchanged in the long run. These restrictions imply that the dynamic effects on real GDP of consumer prices, money and the interest rate are offsetting in the long run, and that the same is true for the impact of prices and money on the interest rate (long-run neutrality of money).

All the variables included in the model are seasonally adjusted with the exception of the interest rate. The lag length k was set to five quarters, which is the optimal value according to the Akaike criterion. Before turning to the impulse

[25] It should be noted that we do not select a monetary aggregate with a stable long-run money demand function in levels such as M3. We are only interested in a money stock concept providing a lot of information for the identification of a monetary policy shock. The monetary base was not used as the introduction of the electronic Swiss Interbank Clearing System and

response estimates, let us briefly mention that the LR test statistic for the null hypothesis of the overidentifying restrictions is 5.89. Under the null hypothesis, this statistic has a chi-square distribution with five degrees of freedom. Therefore, these restrictions cannot be rejected at any reasonable significance level.

Fig. 9 shows the estimates for the cumulated impulse responses of the four (level) variables to the money supply shock. In order to get the required information, we run 200 bootstrap replications of the OLS residuals corrected for their heteroscedasticity. The various panels in fig. 9 show the median as well as the first and third quartile of these replications. By and large, these response estimates correspond to the views held by most macroeconomists in Switzerland about the effects of monetary policy. First, there is evidence of a short-run negative liquidity effect on the interest rate extending over four quarters. The positive reaction in real GDP[26] starts after a year, reaches its peak after two years and peters out after another year. With respect to prices, it takes six quarters until a major positive effect is felt and 14 quarters are needed for full adjustment of prices. After about the fourth quarter, rising prices and inflation expectations cause the interest rate to overshoot temporarily its long-run equilibrium level.

Swiss monetary policy can now be analyzed by deriving conditional forecasts from the SVAR model. Specifically, we determine a sequence of policy shocks required to satisfy such conditions as an average inflation target over a three-year

the relaxation of banks' liquidity requirements in 1988 strongly distorted even the rates of change in this aggregate.

[26] The negative one-quarter lagged impact of the monetary shock on GDP is not easy to explain. However, this effect is not statistically significant because the value of zero lies within a 95 percent confidence band for this impulse response coefficient.

period. Before we turn to this exercise in detail, we have to discuss briefly the appropriateness of our approach.

First, it might be argued that the change in the SNB's monetary regime, as outlined above, invalidates the use of a model fitted to data generated by a different monetary environment. However, we believe that this problem is unimportant in the present context. Price stability remained the ultimate objective of Swiss monetary policy throughout the sample period. Moreover, though the SNB adjusted its operating procedures at the end of 1999, this modification did not cause a break in the time series process of the variables considered in our SVAR model: Bank reserves, used as the main policy instrument before 1999, and the interest rate on repos, the principal new instrument, are not included in our VAR system.

Second, the monetary shocks implied by such a condition as an inflation target should not display a systematic pattern and should not be unusually "large". Otherwise they are subject to the Lucas (1976) critique, as we may expect a shift in the behavior of private agents in the light of such unusual changes. In the words of Leeper and Zha (1999), the policy interventions considered should be "modest". To this end we use a statistic similar to that proposed by Leeper and Zha[27], i.e., the mean of all policy shocks over the *K* forecasting periods:

$$\eta(K,T) = \sum_{i=1}^{K} u_{3T+i} / K$$

[27] These authors use a specification based on the dynamic effects of the policy shocks to all variables of the system. While the Leeper-Zha specification is very similar to that employed here, it seems unnecessarily complicated. Furthermore, the chi-squared distribution of the sum of squared shocks under the null is used as an additional test.

If the mean is statistically different from zero, the policy shocks exhibit a systematic pattern with regard to the average sign of the shocks. Moreover, we may test that the size is too “large” by calculating the sum of the squared policy shocks:

$$Q(K,T) = \sum_{i=1}^{K} u_{3T+i}^2$$

If the policy interventions are not at odds with empirical evidence drawn from the sample, the first expression is distributed with expected value zero and variance 1/*K*, whereas the second expression is chi-squared with *K* degrees of freedom. This hypothesis is easy to test given a sequence of policy shocks obtained by conditioning on a certain policy approach.

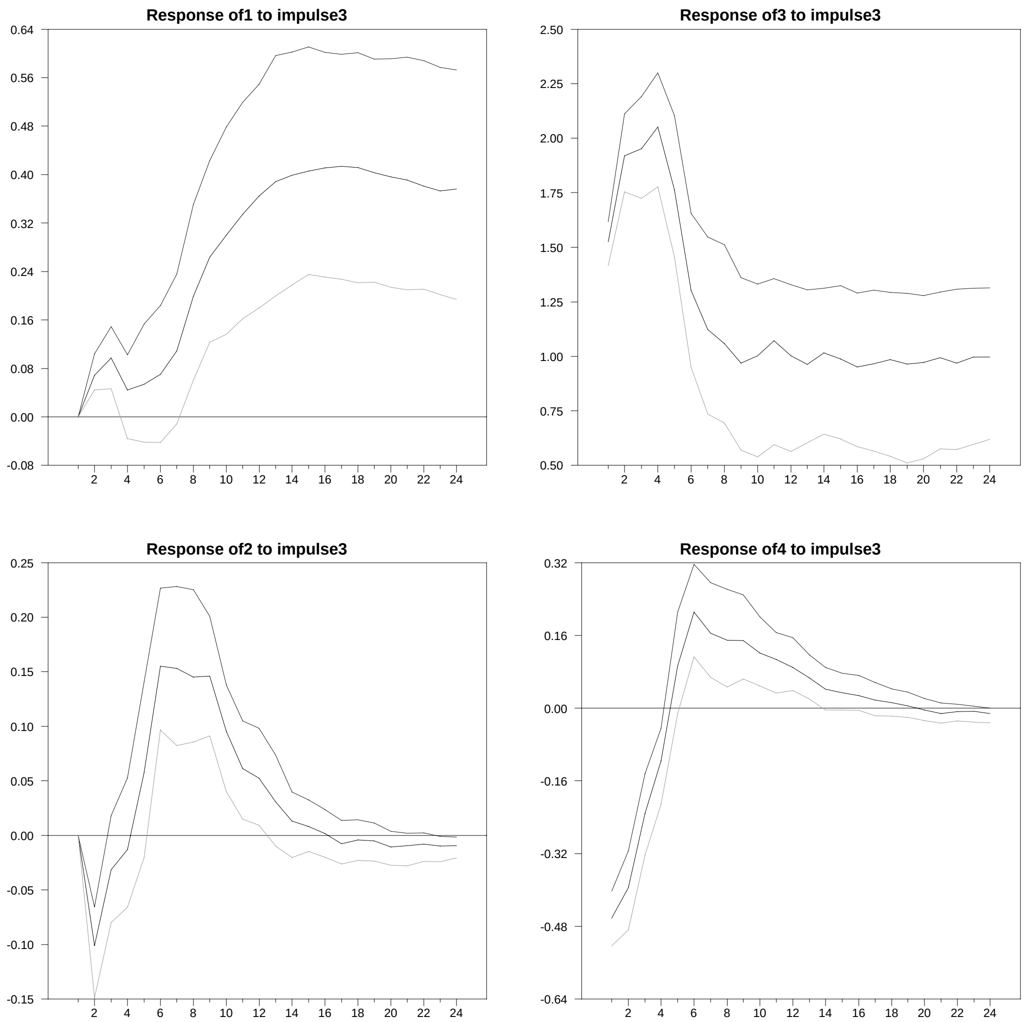
Now consider a monetary policy strategy based on an average inflation forecast for the next *K*=12 quarters, as the SNB has followed since the end of 1999. Take the example of a monetary policy reacting symmetrically to positive and negative deviations from the inflation target. For such a monetary policy, we get conditional forecasts in the following way: We calculate an unconditional one-step forecast and subsequently derive the next-period monetary shock such that the average expected inflation rate is equal to its target value:

$$u_{3T+1} = \frac{1}{BB_{13}(K)}(E_T \log p_{T+K} - (\log p_T + K\pi^*)),$$

where BB is the matrix of the impulse response, cumulated over *K* periods. Thus, the element 1,3 of this matrix gives the *K* period response of the price level to a monetary shock. This shock is now used to adjust the forecasts of all variables according to the current impulse responses. Given this adjusted *T+1* forecast, we calculate again an unconditional one-step forecast for period *T+2* and repeat the adjustment procedure as outlined above. This procedure is followed up to the forecasting horizon *K*.

Figure 9: Impulse response of key macroeconomic variables to a monetary policy shock: SVAR(5), quarterly data 1974-99,
Median and first and third quartile of 200 bootstrap runs

Consumer prices (1) **Money M1 (3)**



GDP (2) **Interest rate (4)**

4.2 Conditional SVAR Forecasts for the Period 1979-80

In this section we apply the conditional SVAR forecasting exercise to the period 1979-80. We assume that the SNB adopted a monetary strategy based on inflation forecasts after it had given up the exchange rate peg. We consider three variants of the exercise, differing with regard to the starting date of the forecast-based strategy. In the first variant, we assume that the SNB adopted this strategy in 1978/IV and set policy on the basis of a three-year inflation forecast for the period 1979/I - 1981/IV. In the other two variants, the starting dates are 1979/II and 1979/IV, with the three-year forecasting period adjusted accordingly. The target (annual) inflation rate for the next three years is set equal to 3 percent. This rate is in line with the SNB's implicit policy objective at the end of the 1970s. Figs. 10 to 12 compare the conditional forecasts obtained by the approach outlined above with the actual development of the variables of interest, i.e., consumer price inflation, growth in real GDP and in the aggregate M1, with the three variables defined as year-on-year rates of change, as well as the level of the interest rate.

Fig. 10 describes the evolution of the hypothetical monetary policy initiated in 1978/IV. It is clearly more restrictive than the course the SNB actually pursued in 1979: M1 growth is 2 to 3 percentage points lower than the actual values. This policy causes the interest rate to rise earlier than it actually did, and allows the SNB to keep forecasted inflation below 3 percent for most of the period 1979-1981. However, it should be noted that the SVAR model understates inflation in the first quarter of 1979 by 1 percentage point and is, therefore, too optimistic in this regard. Not surprisingly, the model forecasts lower GDP growth than actually occurred. The policy interventions appear to be moderate in this case because η equals –1.23 and Q is 4.97. Thus, the hypothesis that the policy interventions are moderate in sign and size cannot be rejected at any reasonable significance levels.

Fig. 11 displays the results that would have obtained if the SNB had initiated the hypothetical monetary policy in 1979/II. In this case the SNB's stance is substantially more restrictive than the actual one (M1 growth lower by 6-8 percentage points over 4 quarters). Nevertheless, the conditional inflation forecasts rise substantially above 3 percent for the next 8 quarters, due to the oil price shock hitting the Swiss economy in the first half of 1979. This hypothetical policy results in expected interventions which are probably too large in size: the Q statistic of 27.48 rejects the null of moderate intervention at the 1 percent significance level, whereas η = -1.03 is in line with moderate interventions with respect to the sign. Thus, the policy interventions required to reach the three-year average inflation target of 3 percent may be systematic and subject to the Lucas critique. If the SNB postpones the start of the forecast-based policy to the end of 1979, things turn even worse: Fig. 12 yields a conditional forecast with a severely restrictive monetary policy stance throughout 1980. Despite the tight course, the low inflation forecasts needed to meet the target over the following three years are attained only after six quarters. The resulting policy interventions are clearly not moderate in size: We obtain a highly significant Q-statistic equaling 85.54 although the average sign is moderate (η=-1.28). These results are explained by the initial sharp tightening, and the subsequent abrupt relaxation of monetary policy after six quarters, as indicated by the conditional forecast.

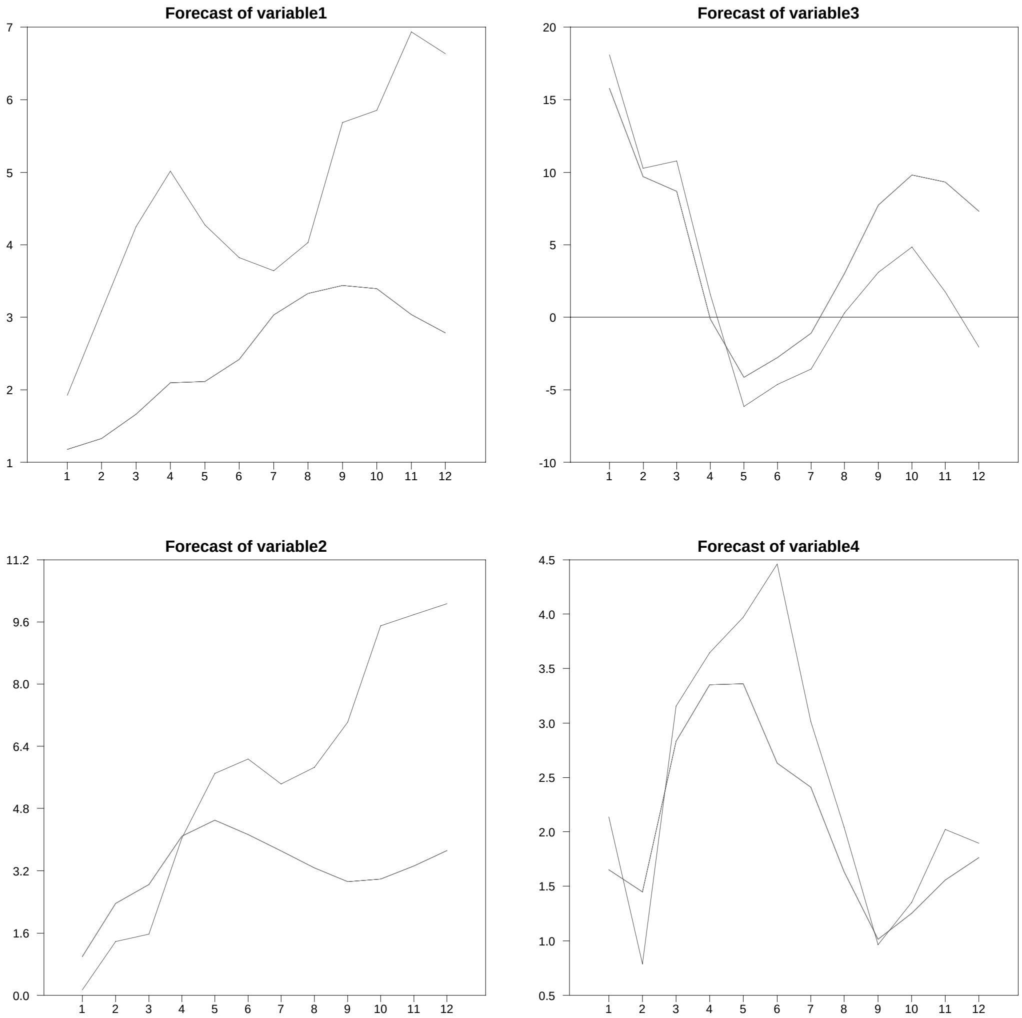
What can we learn from these conditional forecasts about the conduct of Swiss monetary policy in 1979/80? The results obtained above suggest that the SNB could have avoided the surge in inflation in 1981 if it had adopted a restrictive monetary policy already at the beginning of 1979 and tightened its reins further in the course of that year. By contrast, a policy change in the second half of 1979 would have come too late because only a shift to a severely restrictive stance could have kept inflation near the target. We should stress that the effects of such a severe policy shift are difficult to predict with our SVAR model as it implies clearly non-modest policy interventions.

Finally, a comment about the exchange rate is in order. The exclusion of the exchange rate from the SVAR model does not apear to pose problems since the estimation of a five-variable system, including the SFr/DM exchange rate, leaves the impulse response patterns for prices, real GDP, M1 and the interest rate to the monetary shock essentially unchanged. The impulse response function of the exchange rate has the expected shape: An initial overshooting, followed by a long-run adjustment parallel to that of the price level. The only difference to the four-variable system is that the inclusion of a the exchange rate - a noisy variable subject to regime shifts - strongly increases the standard errors of the impulse response estimates. Thus, we prefer the four-variable system for policy analysis. Nevertheless, it is worth mentioning that the conditional forecasts from a system including the exchange rate are qualitatively similar but more volatile than those reported above. For 1979 and 1980, the conditional forecasts of the exchange rate are clearly lower than the actual values, namely around 85 Swiss francs per

100 DM as compared to the actual value of about 91. However, the floor of substantially above 80 is not violated.

Figure 10: Conditional Forecasts of Annual Rates of Change in Inflation, M1 and Real GDP, and of the Interest Rate Level, Conditional on a Forecast-Based Policy, 1979/I-1981/IV (forecasts green line, actual values red line)

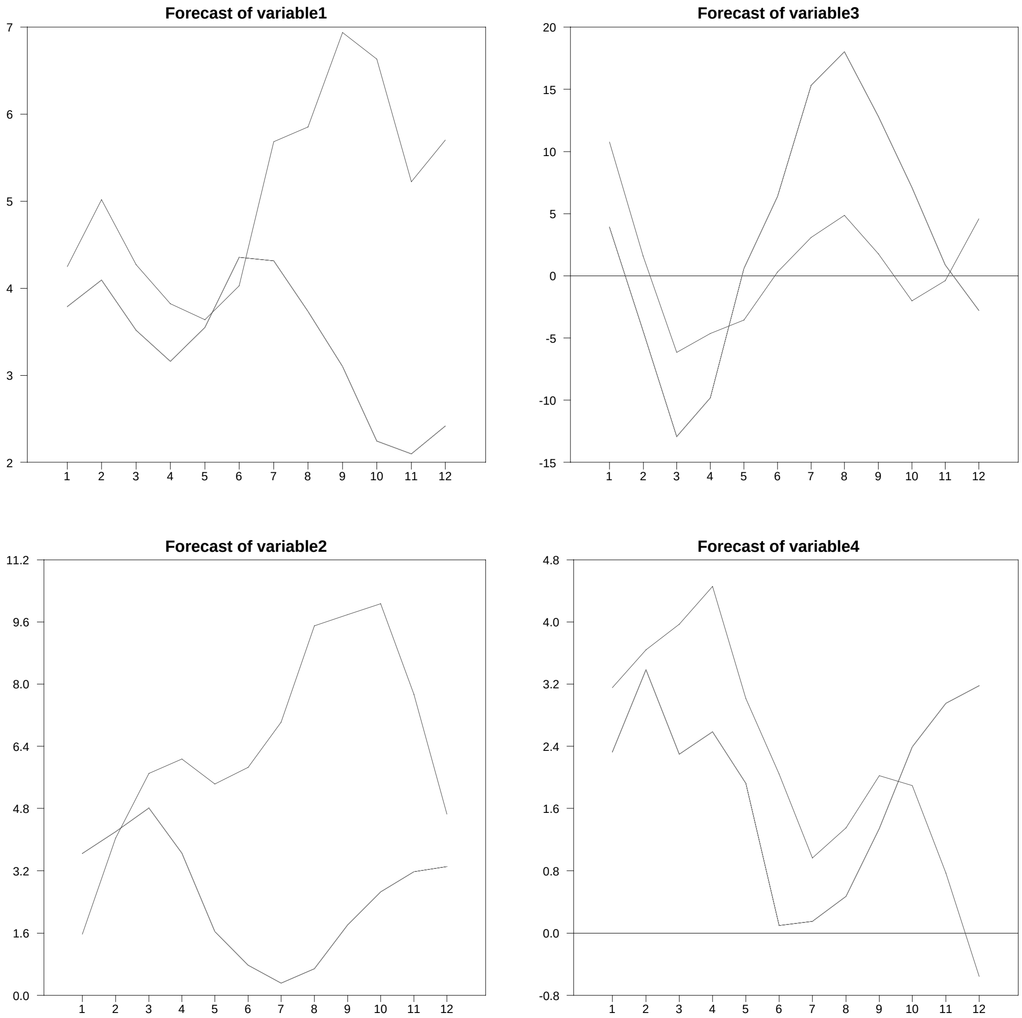
Inflation **M1 Growth**



Interest Rate **GDP Growth**

Figure 11: Conditional Forecasts of Annual Rates of Change in Inflation, M1 and Real GDP, and of the Interest Rate Level, Conditional on a Forecast-Based Policy, 1979/III-1982/II (forecasts green line, actual values red line)

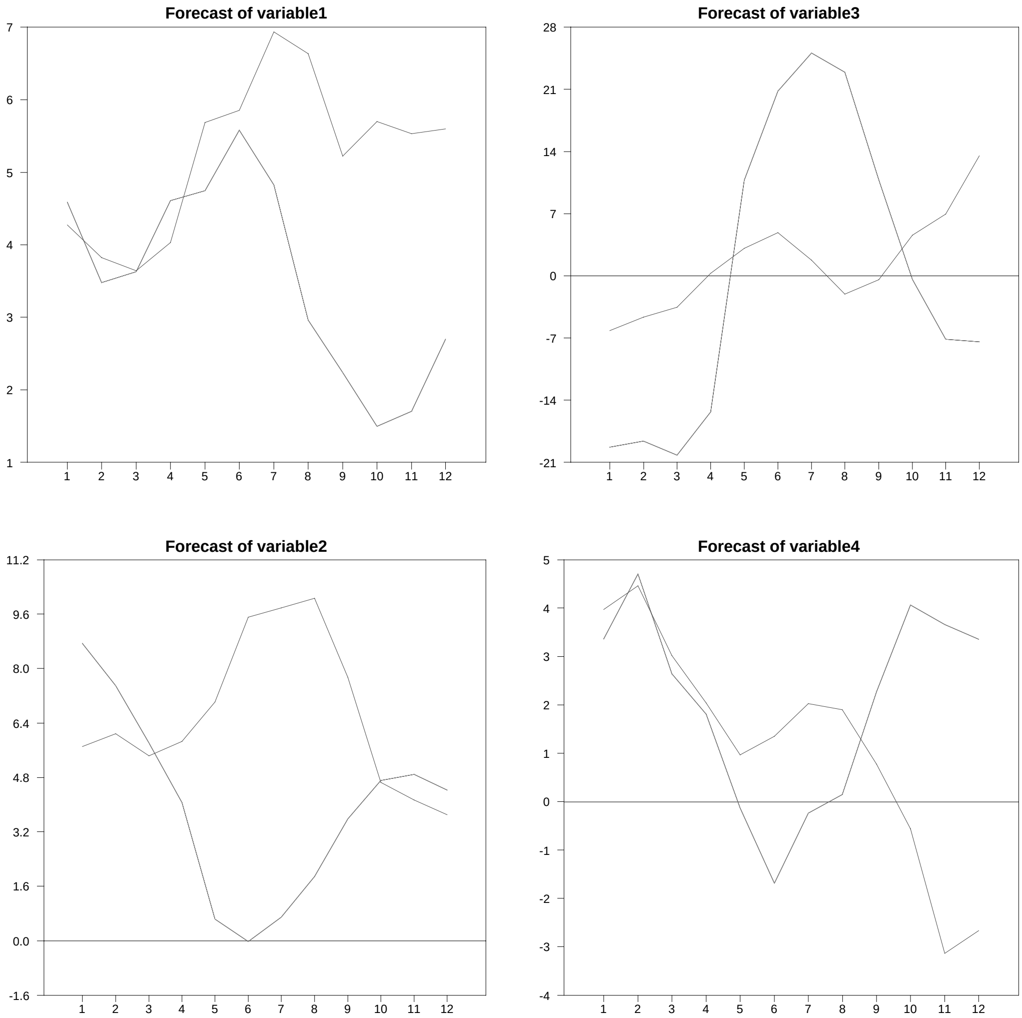
Inflation **M1 Growth**



Interest Rate **GDP-Growth**

Figure 12: Conditional Forecasts of Annual Rates of Change in Inflation, M1 and Real GDP, and of the Interest Rate Level, Conditional on a Forecast-Based Policy, 1980/I-1982/IV (forecasts green line, actual values red line)

Inflation **M1 Growth**



Interest Rate **GDP-Growth**

5. Conclusions

This paper addressed the problems arising from the conduct of monetary policy in a low-interest-rate environment. We examined a proposal advanced by Svensson (2000) in the context of the current debate on Japanese monetary policy. If such a country as Japan faces a deflationary shock in an environment of low interest rates, the central bank may find it difficult to relax monetary policy because the attendant fall in interest rates may be constrained by a zero bound. In these circumstances, Svensson suggests that the authorities should first devalue the domestic currency and then fix a temporary target for the exchange rate, coupled with an inflation target. These measures cause real interest rates to fall even though nominal rates, at least at the short end of the maturity spectrum, rise. Thus, they help to stimulate economic activity. The temporary peg should be maintained until deflation disappears.

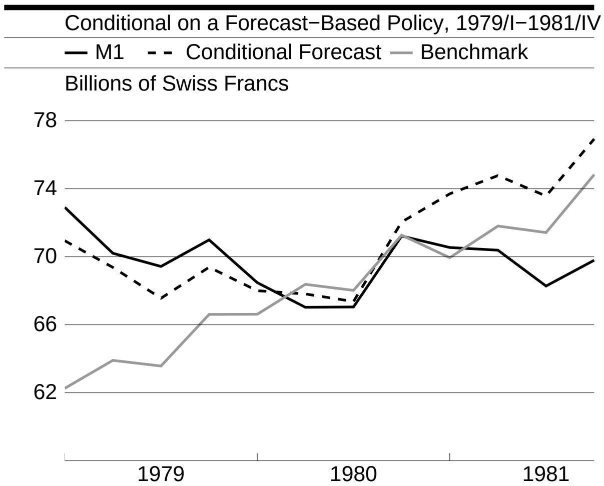
Swiss monetary experience of the late 1970s and early 1980s sheds light on the question of whether Svensson's proposal is likely to work in practice. In 1978, Switzerland faced a threat of deflation, caused by an excessive real upvaluation of the Swiss franc on the foreign exchange market. Since short-term interest rates were already very low, it was difficult to relax monetary policy in response to the exchange-rate shock. Therefore, in the autumn of 1978, the SNB set a temporary exchange rate target. While this measure successfully removed the deflation threat from the Swiss economy, it caused a new problem: The temporary change in monetary regime triggered an economic boom that - in due course - lead to a resurgence of inflation.

Even with hindsight, it is unclear why the SNB failed to preserve price stability. The shift to a temporary peg prompted an explosive increase in the money supply. In 1979, the SNB strove to reduce the monetary overhang again. It is possible that the SNB created a potential for inflation by not eliminating the monetary overhang quickly enough. Another possibility is that the SNB's approach to monetary targeting was flawed. The SNB thought that all it had to do was to remove the monetary overhang in order to preserve price stability. Perhaps the SNB should have tightened monetary policy further when it became aware of the strong economic recovery triggered by the temporary peg.

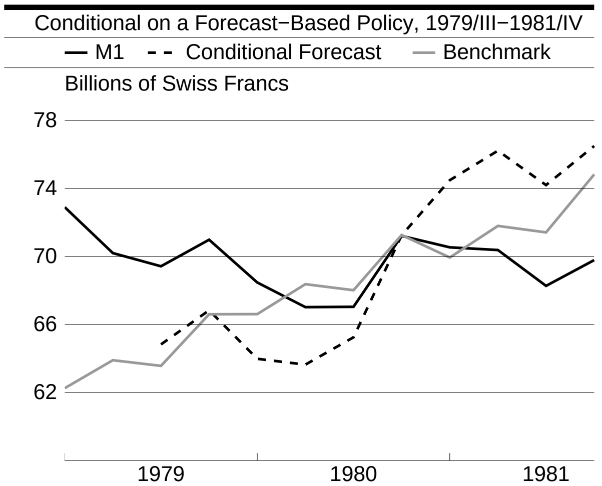
In attempt to answer the question of why the SNB failed to preserve price stability, we apply structural VAR analysis to four key Swiss economic variables: Consumer prices, real GDP, the money stock M1 and a short-term interest rate. In particular, we ask how these variables would have evolved, had the SNB relied on inflation forecasts, coupled with an inflation target of 3 percent, rather than on monetary targeting, from 1979 onwards. The VAR analysis yields two conclusions:

First, unlike suggested by Svensson, nominal Swiss interest rates did not rise after the SNB had switched to a temporary peg. On the contrary, the massive increase in the money supply released the usual liquidity effects by lowering nominal interest rates further. For a while, they attained slightly negative values in 1979.

Desired M1 Level — Figure 13



Desired M1 Level — Figure 14



Second, in figs. 13 and 14 we compare the conditional forecasts for the money stock M1, derived from the structural VAR model, with the actual values and the benchmark, as shown in fig. 5B. Since the VAR analysis is based on quarterly data, figs. 13 and 14 incorporate quarterly averages of the monthly data exhibited in fig. 5B. Note that the VAR analysis yields forecasts of quarterly rates of change in seasonally-adjusted M1, while fig. 5B contains seasonally-unadjusted levels in that aggregate. To convert seasonally-adjusted rates of change to seasonally-unadjusted levels, we employ the following procedure: Fig. 13 shows the conditional forecasts of the level of M1 for the period 1979/I - 1981/IV, on the assumption that the forecasts we produced in 1978/IV. The corresponding forecasted rates of change may be obtained from the upper-right panel in Fig. 10. To derive the forecast for the level of M1 in 1979/I, we apply the corresponding forecast for the rate of change to the *actual* value of M1 for 1978/IV. Moreover, the forecast for the level in 1979/II is calculated by applying the corresponding forecast of the rate of change to the forecasted level for 1979/I, and so on. To obtain seasonally unadjusted forecasts for the level of M1, we add the corresponding seasonal factors to the forecasts derived from the VAR model.

According to fig. 13, the SNB, in the first quarter of 1979, should have shifted back to a restrictive monetary policy much more decisively than it actually did in order to preserve price stability. However, it need not have returned to the benchmark earlier than at the beginning of 1980. Moreover, had it followed this course, it would not have been obliged to push M1 below the benchmark line in 1981.

Even so, we doubt that the SNB could have followed the course traced out by fig. 13. Had it dropped the temporary-exchange rate target and shifted to a strongly restrictive stance as early as at the beginning of 1979, it would likely have reinvigorated the exchange rate turbulence it sought to quell. A more realistic alternative is described by fig. 14. In this case, the SNB would have dropped the temporary-exchange rate target in the third quarter of 1979. To preserve price stability, the SNB should have lowered M1 to the benchmark right away. Moreover, it should have pushed M1 below the benchmark temporarily in 1980. Thus, the VAR analysis clearly indicates that both factors mentioned above - tardy elimination of the monetary overhang and a flawed approach to monetary targeting - accounted for the rise in inflation in 1981.

These results point to an important dilemma that central banks are likely to face if they consider setting a temporary exchange rate target in the presence of a deflation threat: It is not clear whether the SNB could have eliminated the monetary overhang more rapidly without reigniting the exchange turmoil it had earlier tried to suppress. We should also add a note of caution: Our analysis does not imply that reliance on an inflation forecast would have improved the SNB's performance in 1979 since our VAR analysis uses information not available to the SNB at that time. However, a forecast-based strategy, as the SNB adopted at the end of 1999, would likely be the best alternative if the SNB were to face a similar situation again in the future.

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