Stability of Swiss Money Demand: Evidence for 1982–87

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The Swiss National Bank (SNB) is one of the few central banks that announces and, with only occasional exceptions, achieves targeted growth rates for a monetary aggregate. After the 1973 switch to floating exchange rates permitted countries to pursue independent monetary policies, the SNB first targeted M_1; increasing difficulties with predicting variations in the money multiplier induced a switch in 1980 to a target for the monetary base. Although actual base growth was substantially less than its target rate in 1980–81, the largest subsequent deviation was the 2.9 percent actual growth rate of the monetary base relative to its targeted value of 2.0 percent in 1987. The desired and actual result of such monetary control, of course, has been price stability.

For the direct control of a monetary aggregate to continue to produce the desired price stability in the future, the Swiss demand for money function must be stable. Casual inspection of the data since 1981, however, suggests a downward shift in the demand for real balances and an upward shift in velocity. Moreover, Chow test results reported by Kohli (1985), were suggestive of a shift in money demand in 1982 even though the tests were based on annual data only through 1983.[1] Although the direction of these suspected shifts would be opposite from the upward shifts that have been observed in many industrialized economies, most notably the U.S., they nonetheless would carry important implications for the conduct of Swiss monetary policy. In particular, a significant downward shift in money demand would argue for lower target values and slower actual growth for the monetary base. Testing for the significance of such a shift is the objective of this paper.

Previous Work on Swiss Money Demand and Monetary Targets

Kohli and Rich (1986) reported the following result for a real-adjustment version of the demand for base money (estimated over 1968:1–1982:4):

$$\ln\left(\frac{M_0}{P}\right) = \underset{(0.31)}{0.338} + \underset{(2.20)}{0.366}\ln(y) - \underset{(3.61)}{0.015}r_s - \underset{(1.46)}{0.028}D73 + \underset{(6.00)}{0.588}\ln\left(\frac{M_0}{P}\right)_{t-1} \quad (1)$$

$\bar{R}^2 = 0.74$ DW = 1.79 SEE = 0.048

M_0 is the nominal monetary base, P is the GDP deflator, y is real GDP, r_s is the interest rate on 3-month bank deposits and D73, which represents the change from fixed to flexible exchange rates, takes a value of 1 for 1973:1 and all subsequent quarters. The authors report, after additional tests, that this specification is adequate to be employed for the determination of a target value for base growth that is consistent with the objective of long run price stability.

How is such a determination made in practice?[2] Treating the interest rate and the price level as constants and projecting the trend rate of growth in Swiss GDP, the income elasticity from equation (1) can be used to calculate a noninflationary path for the monetary base that also is sufficient to accommodate increases in the demand for money balances associated with growth in real economic activity. The long-run income elasticity from equation (1) is [0.366/(1–0.588)] = 0.89. This estimate says that a one percent increase in real economic activity will increase the demand

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[1] Heri and Kugler (1987) and Rötheli (1988) also have detected short-run instability in Swiss money demand equations but did not address specifically the recent phenomenon.

[2] For more detail on this process, see Kohli-Rich (1986), pp. 921–922.

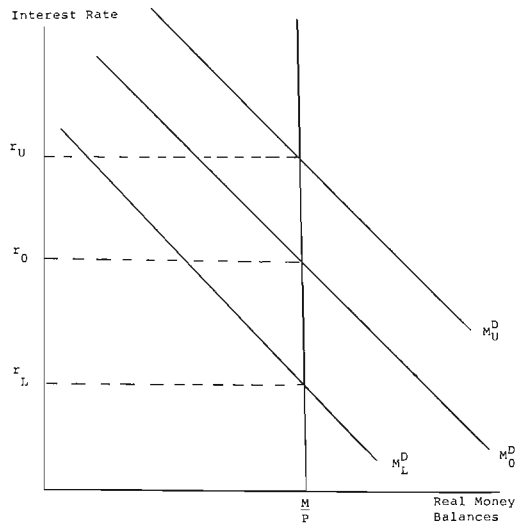
for real money balances (and nominal balances, as well, under the assumption of a constant price level) by 0.89 percent. Using an estimate of 2 percent for the trend growth of real GDP, a lower bound for base growth is $2 \times 0.89 = 1.78$ percent per year. In reality, the gradualist policy of the SNB toward reducing inflation has resulted in somewhat higher (2.0 percent) targets for base growth and an inflation rate in the range of 1–2 percent.

Shifts in Money Demand and Monetary Control

Two types of shift in money demand can affect the usefulness of the foregoing approach to monetary control, albeit in quite different ways. The first, which would complicate using this approach, would be repeated random shifts in money demand. In such a case, as shown in figure 1, the central bank still could control the supply of money balances ($\frac{M}{P}$) by conducting the appropriate open market operations. It would be in doubt, however, as to the position of money demand between some upper and lower bounds, M_u^D and M_L^D. If M_0^D were the central bank's "best guess" of money demand, but it actually had shifted up to M_u^D, controlling the money stock as if M_0^D were true would result in money growth that was too slow and, quite possibly, a recession. Conversely, if money demand has shifted down to M_L^D, actual money growth based on M_0^D will be faster than desired.

The severity of this problem depends on many factors, including the magnitude of these shifts, the length of time that passes before a shift is identified and, perhaps most important, whether the shifts tend to fluctuate in offsetting fashion around the "true" function or tend to persist in one direction. Generally speaking, monetary control for the central bank becomes more difficult as money demand fluctuates more often and by larger amount between M_u^D and M_L^D and the shifts, on net, move the function away from the current "best guess" of the "true" money demand function's location. For example, if money demand varied between M_u^D and M_L^D from quarter to quarter but, on average, tended toward M_0^D, a money growth path could be established on the basis of M_0^D and not interfere with a long run objective such as price stability. If, however, the random shifts in money demand had the net effect, over time, of moving the function above M_0^D, the current basis for money growth targets, actual money growth would be too slow. If the central bank then failed to identify this upward drift in money demand and persisted in targeting money growth on the basis of M_0^D, a falling price level and recession would be possible long-run consequences of this error. Conversely, if the current conjecture that money demand has shifted down is true, current targeted and actual growth rates for the monetary base may risk a rising price level.

Figure 1.
An Illustration of Shifts in Money Demand



The second type of shift is a one-time shift in money demand to a new level. The problem is analogous to figure 1, in which there (temporarily) is a gap between the true and estimated money demand functions. A one-time shift in the function should cause only short-run errors in monetary control until the shift is identified and can be accommodated with an adjustment in the money supply. The severity of the central bank's problem, of course, still depends upon the magnitude of the shift and the length of time that transpires before the shift is identified and the appropriate correction in money growth is made.

Testing for Shifts in Swiss Money Demand

Chart 1, reproduced from Rich (1987), certainly is suggestive of a shift (or shifts) in Swiss money demand after 1981. After exhibiting the expected positive relationship through 1982, with changes in interest rates causing changes in velocity in the same direction, this association has not been apparent in the past five years. In particular, the chart shows a sharp decline in interest rates in 1982–83 but no corresponding decline in the velocity of either the monetary base or M_1. Rich, who notes this evidence of a post-1981 shift in Swiss money demand, also notes that none of the explanations offered to date has been convincing. Heri (1986) also finds evidence of a shift in money demand in the early 1980s.

The two types of money demand shifts discussed above can be discriminated in a straightforward manner. The existence of a one-time shift in 1982 can be tested using a dummy variable that partitions the data at that date. The possibility that frequent random shocks to the real sector have made money demand more unstable in the short run can be examined using a related test that also serves as a second check on the hypothesis of permanent structural change.

We begin by re-estimating equation (1) for the period 1968:1, 1986:4.[3] The results of this estimation, both for the monetary base and M_1, are reported in table 1. Rows (a) and (c) of the table report results that do not consider a recent structural change. They contrast with those of Kohli-Rich in several important ways: the income effects are small numerically and nonsignificant, the intercepts are smaller and, in the M_1 equation, the presence of autocorrelation is suggested. Together, these changes are suggestive of a shift in the function.

Rows (b) and (d) of the table consider the same model with an intercept shift (D8287) at 1982:1.

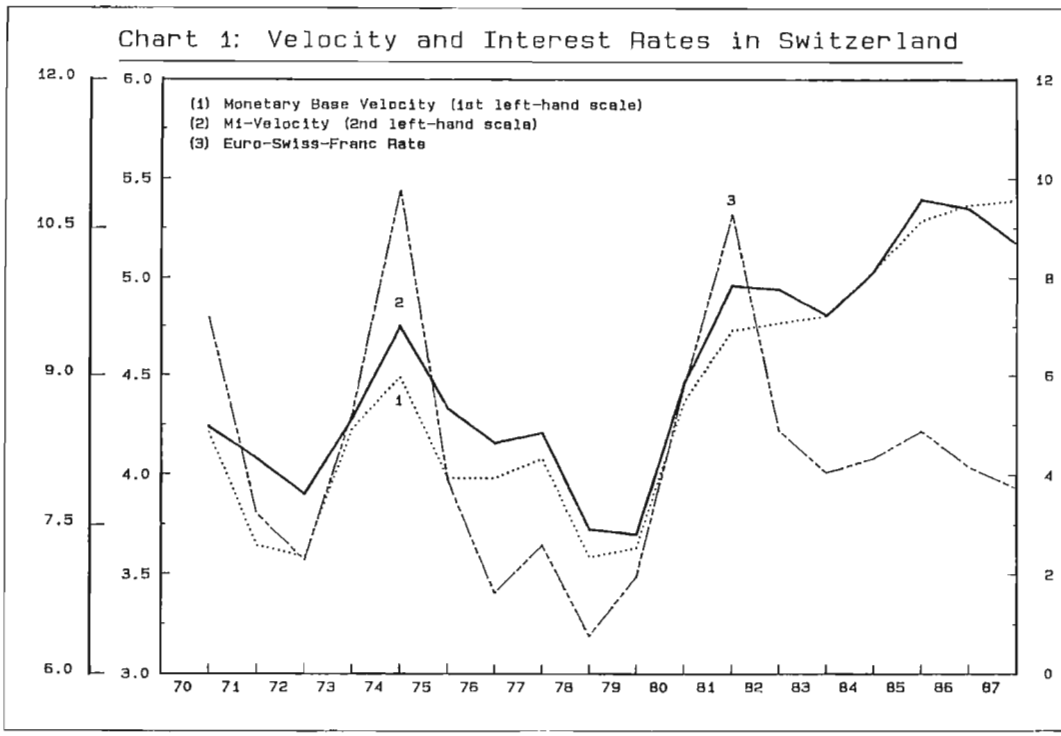


Table 1: Short-Run Money Demand Functions, 1968:1–1986:4

Monetary Base

Row	Intercept	ln(y)	r_s	$\ln(\frac{m}{P})_{t-1}$	D73	D8287	$\bar{R}^2$	DW
a)	1.406	0.032	−0.010	0.697	−0.009	—	0.63	1.85
	(2.02)	(0.27)	(2.61)	(8.97)	(0.43)	—		
b)	0.528	0.358	−0.016	0.526	−0.021	−0.068	0.66	1.79
	(0.72)	(2.19)	(3.68)	(5.45)	(1.05)	(2.77)		

M1

	Intercept	$\ln(\frac{y}{P})$	r_s	r_L	$\ln(\frac{m}{P})_{t-1}$	D73	D8287	$\bar{R}^2$	DW
c)	1.113	0.063	−0.008	−0.008	0.760	−0.020	—	0.79	2.51
	(2.32)	(0.92)	(2.96)	(1.46)	(13.51)	(1.64)	—		
d)	0.943	0.299	−0.008	−0.018	0.576	−0.027	−0.056	0.82	2.24
	(2.11)	(3.27)	(3.38)	(3.14)	(7.86)	(2.40)	(3.57)		

Note: Absolute values of t-statistics in parentheses

Even though the overall fits of the equations are little changed, allowing for this break brings the estimated coefficients more in line with expectations: the income coefficients are positive and significant and, for M_1, the long-term interest rate coefficient now is significant and negative. More important, however, is that for both models the intercept shift variable, D8287, is revealed to be significantly negative, as hypothesized. Thus, there appears to be some evidence that the money demand function has shifted down since the end of 1981. But did this shift occur as a one-time event or has it been the result of a series of shocks with a negative *net* effect over some series of periods?

One-Time Shifts vs. Increased Instability and Gradual Adjustment

The simple evidence in table 1 indicates a downward shift in money demand. Such a change could occur, however, for quite different reasons. In the simple case, some discrete change occuring at 1981:4 could have caused a one-time permanent shift of the function to a lower level; in this case, the functions reported in rows (b) and (d) of table 1 would be stable and one could continue to estimate income, interest rate and adjustment coefficients reliably so long as this shift were taken into account. A second possibility is that the shift observed in table 1 is the result of a series of shifts that, on net, have moved the function to a lower position.

A procedure that can discriminate between the two types of shifts has been suggested by Dufour (1980). An equation such as (1) again is applied to represent the demand for real balances. Rather than segmenting the sample with a single dummy at an hypothesized break point, a series of dummies is introduced. The series contains a unique dummy for each observation after the hypothesized break and indicates which "forecast" error(s) differ significantly from the structure established by the regression estimated up to the break point. Thus, if the coefficients for the individual dummies tend to be significant, by ordinary t-statistics, the inference would be that the model has been affected by larger random shocks in the post-break period. If the sum of coefficients for all of the dummies also is significantly different from zero, the inference is that the short-run shocks have not been offsetting but, rather, have had the net effect of shifting the function in one direction.[4] These tests were implemented by estimating equation (1) over the period 1968:1–1981:4 and adding 20 separate dummy variables for the 20 observations 1982:1–1986:4. The results of this estimation are reported in table 2.

[3] The X-11 seasonal adjustment procedure was applied to the monetary base, M_1, nominal GDP and the GDP deflator and the seasonally adjusted data were used in the money demand estimation.

[4] An illustration of these tests for U.S. money demand is in Hafer (1985).

Table 2:
Estimates of Post-1981 Short-Run Instability

	Monetary Base		M1	
Intercept	−0.111	(0.12)	0.654	(1.41)
ln(y)	0.547	(2.43)	0.328	(2.93)
r_s	−0.019	(3.55)	−0.008	(3.20)
r_L	—	—	−0.018	(2.96)
$\ln(\frac{m}{p})_{t-1}$	0.452	(3.72)	0.599	(7.19)
D73	−0.035	(1.42)	−0.030	(2.54)
82:1	−0.010	(0.16)	−0.050	(1.51)
82:2	0.077	(1.14)	−0.032	(0.91)
82:3	−0.098	(1.47)	−0.083	(2.44)
82:4	−0.057	(0.85)	0.001	(0.03)
83:1	−0.067	(1.01)	−0.039	(1.20)
83:2	−0.102	(1.53)	−0.054	(1.62)
83:3	−0.091	(1.35)	−0.086	(2.60)
83:4	−0.063	(0.93)	−0.016	(0.47)
84:1	−0.070	(1.06)	−0.042	(1.27)
84:2	−0.123	(1.77)	−0.061	(1.79)
84:3	−0.080	(1.19)	−0.072	(2.14)
84:4	−0.053	(0.78)	−0.010	(0.28)
85:1	−0.078	(1.16)	−0.087	(2.59)
85:2	−0.090	(1.26)	−0.049	(1.31)
85:3	−0.126	(1.79)	−0.105	(2.92)
85:4	−0.101	(1.37)	−0.027	(0.71)
86:1	−0.120	(1.69)	−0.094	(2.63)
86:2	−0.141	(1.85)	−0.078	(1.98)
86:3	−0.150	(2.00)	−0.113	(2.93)
86:4	−0.103	(1.31)	−0.028	(0.69)
$\bar{R}^2$		0.57		0.83
DW		1.79		2.12
$\sum_{i=1}^{20} D_i = 0$		8.07		9.73

Note: Absolute values of t-statistics in parentheses

For the monetary base, as shown in the first column of coefficients and t-statistics, 19 are negative numerically, one is significantly negative and three others are nearly significant. Moreover, consistent with the result in table 1, the sum of these dummy coefficients is significantly negative, indicating a downward shift in the demand for base money.

The results for M_1 are somewhat stronger. Six (and nearly another) of the twenty dummies are significantly negative and the sum of dummy coefficients also is significantly negative. Moreover, four of the six significant dummies occur after 1984, which may indicate that, although the M_1 demand function indeed is shifting downward gradually in response to a series of real shocks, the timing of this shift may be later than the 1981–82 break suggested by the plotted data.[5] Nonetheless, the evidence in table 2 does indicate significant short-run instability in money demand that, on net, has caused a downward shift in the function. It is not possible to determine, however, whether these shifts have been completed or whether negative short-run shocks are continuing to shift the function downward.

Sources and Consequences of the Shift in Money Demand: Further Results

At least two additional questions are raised by the shifts in money demand that have been identified. The first is whether it is possible to associate the shift with any particular M_1 component, which may suggest a change in the costs or technology of the payments mechanism and financial management.

The second is whether the shift in demand for base money and M_1 balances has occured in the broader aggregates, M_2 and M_3, as well. If so, the implication would be a shift out of bank financial assets generally beyond the shift out of M_1 balances. Conversely, if the demands for M_2 and M_3 balances are unchanged, the result would be suggestive of a shift out of M_1 balances into the interest-bearing deposits of the broader aggregates. Each of these issues is investigated below.

Shifts in M_1 Components

Equations of the same form as (1) were applied to currency, postal checking deposits and sight deposits over the same 1968:1–1986:4 sample

[5] This possibility was investigated by re-estimating equation (1) with the intercept shift variable, D8287, redefined to begin at, respectively, 1983:1, 1984:1 and 1985:1. For all cases, the general characteristics of the model deteriorated progressively as the shift moved away from 1982:1.
In personal correspondence, Ulrich Kohli suggested including a trend term, beginning in 1982:1, to discriminate between one-time shifts in the regression intercept and a gradual downward trend in the function. Re-estimation of the models with this trend, however, uniformly found it to be nonsignificant and the intercept dummy results to be largely unaffected.

Table 3:
Demand Equations for M_1 Components

	Currency	Postal Checking Deposits	Sight Deposits
Constant	0.175	−0.027	−0.175
	(0.55)	(0.08)	(0.49)
ln(y)	−0.133	0.119	0.429
	(0.39)	(1.58)	(4.76)
r_s	−0.003	−0.000	−0.022
	(3.42)	(0.16)	(9.61)
r_L	—	−0.012	−0.018
	—	(2.30)	(3.47)
$\ln(\frac{m}{P})_{t-1}$	0.981	0.852	0.608
	(18.31)	(14.06)	(13.03)
D73	−0.001	0.011	−0.059
	(0.21)	(0.95)	(5.66)
D8287	−0.001	−0.025	−0.053
	(0.17)	(2.46)	(3.78)
$\bar{R}^2$	0.91	0.95	0.96
DW	1.75	2.66	1.44

Note: Absolute values of t-statistics in parentheses

period; as before, the data were seasonally adjusted by the X-11 procedure prior to estimation. Variable names apply to the same measures as previously and, as before, the nmeumonic $\ln(\frac{M}{P})_{t-1}$ refers to the lagged value of that equation's dependent variable. Results are reported in table 3.

The results indicate no structural change in the demand for currency, although the apparent random walk characteristics of currency demand raise some cautions about this interpretation of the results. The tests, however, did detect declines in the intercepts for both postal checking deposits and sight deposits after 1981:4. The implication is that some exogenous change occuring near that date has caused, for some level of interest rates and real income, a reduced desire to hold money balances in these two types of accounts.

Shifts in M_2 and M_3

The remaining question is where the money balances formerly in postal checking and sight deposits have gone. One possibility is into nonbank financial assets such that similar downward shifts in M_2 and M_3 should be observed. Another possibility is that reduced balances in M_1 accounts have been shifted into the savings or time deposits of M_2 and M_3 that pay higher rates of return; if so, moving funds from M_1 accounts into the broader aggregates would not affect the demand relations for M_2 and M_3.

Again applying a form of equation (1) to M_2 and M_3, the results in table 4 were produced. In neither case is the intercept shift variable (D8287), for a structural change at 1981:4, significantly different from zero.[6] In conjunction with earlier results, this implies that funds have been moved from postal checking and sight deposits into the time or savings deposits of the broader aggregates.

Table 4: Demand Equations for M_2 and M_3

	M_2	M_3
Constant	−0.169	0.714
	(0.23)	(1.22)
ln(y)	0.394	0.139
	(3.19)	(1.01)
r_s	0.013	−0.002
	(2.89)	(0.65)
r_L	−0.020	−0.019
	(2.28)	(1.98)
$\ln(\frac{m}{P})_{t-1}$	0.685	0.801
	(9.54)	(9.01)
D8287	−0.017	−0.003
	(1.36)	(0.33)
$\bar{R}^2$	0.96	0.95
DW	2.13	2.12

Note: Absolute values of t-statistics in parentheses

Summary

Plots of velocity for the monetary base and M_1 suggest a downward shift in Swiss money demand since 1981. This conjecture was investigated by applying a conventional money demand function to post-1981 data. Tests consistently revealed significant shifts in the intercepts of both. Moreover, additional tests revealed, at

[6] Note that these regressions do not include a dummy variable for the switch in exchange rate regimes because data are available only since 1975:3.

least for M_1, that the changes may derive from a series of short-run shocks that have become significant individually in the post-1981 period. Thus, rather than a discrete shift that is easily identified, the Swiss money demand function appears to be evolving slowly to a new equilibrium level. Finally, the origins of this downward drift in M_1 demand appear to be downward shifts in the demands for postal checking and sight deposits as funds are moved from these accounts into accounts within the broader M_2 and M_3 aggregates.

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