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ABSTRACT

This paper investigates the substitutability between money and near-money assets during the period 1976 to 1996 in Switzerland. Financial developments have made a variety of instruments available to store wealth and conduct economic transactions. These developments have generated a "near money" component in households' and businesses' portfolio balances. It is important to evaluate the effect of "near-money" on money demand and the effectiveness of monetary policy. Towards this goal, five monetary assets: currency and demand deposits at commercial banks, demand deposits with the postal system, deposits on transaction accounts with banks, savings deposits and time deposits are considered. We evaluate the degree of substitutability among these assets using the Morishima elasiticity. Results show that various monetary assets substitute for one another. Consistent with a high degree of diversification, the Morishima elasticity is significantly larger when adjustment takes place in the price of a relatively broader monetary asset as compared with a narrower one. Targeting a broad monetary aggregate captures a variety of assets that contribute to liquidity and aggregate demand, enhancing the effectiveness of monetary policy. Nonetheless, high elasticity of substitution between monetary assets has made it increasingly difficult to target money demand via changes in the interest rate. As a result, in 1999 the Swiss National Bank abandoned monetary targeting in favor of an expected inflation target.

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1. INTRODUCTION

Financial development has created a range of financial innovations that have become increasingly popular for transactions and savings. The surge of these developments has led to an increasing literature that evaluates the effects of financial deepening on output growth.[1] At the core of this relationship is the effect of financial innovations on money demand and, in turn, the effectiveness of monetary policy. More specifically, the proliferation of alternative financial assets during the last two decades is likely to have affected the degree of substitution across different monetary assets and, therefore, the interest sensitivity of money demand. The design of monetary policy requires an accurate forecast of money demand and, therefore, velocity. If the elasticity of substitution between monetary assets is known and relatively small, the central bank's ability to predict money demand is enhanced. Given this prediction, the central bank targets developments in the monetary aggregate to accommodate money demand and determine aggregate economic conditions. Changes in the degree of substitution between monetary assets may affect, therefore, the stability of money demand and, in turn, the effects of monetary growth on price inflation and output growth.

The issue of the substitutability between monetary aggregates dates back to Gurley and Shaw (1955, 1956), who questioned the ability of US monetary authorities to reduce liquidity in the post-war economy following an increase in the liabilities of financial intermediaries. Johnson (1962) further developed the Gurley-Shaw argument. If the liabilities of financial intermediaries are close substitutes for currency, the interest sensitivity of money demand decreases. A contractionary monetary policy raises the interest rate and decreases currency demand. Nonetheless, the increase in the interest rate increases demand for bank deposits, reducing the interest sensitivity of money demand. Monetary policy must induce, therefore, a large change in the interest rate to bring the money market back to equilibrium. The change in the interest rate increases the effects of monetary policy on economic activity. High degree of currency substitution may render, however, these changes ineffective to achieve the monetary policy target.

The term "near money" refers to financial assets that substitute for cash money in agents' portfolio balances. Subsequently, researchers have investigated the degree of substitution between currency and assets that constitute "near money." The pioneer investigation was by Chetty (1969) who empirically examined the issue for the U.S. economy and found very high elasticity between narrow money, M1, and other assets such as time deposits, savings and loan association shares and deposits at mutual savings banks. Subsequently, a number of studies examined the degree of substitutability between money and near monies [see Feige and Pearce (1977) for a detail survey]. Later, Boughton (1981) reestimated Chetty's model with updated data and found the elasticity of substitution to be much smaller. Husted and Rush (1984) further evaluated the Chetty-Boughton results and reported elasticities which were even smaller than those obtained by Boughton. Later studies for the US [Ewis and Fisher (1984), Sims, Takayama and Chao (1987) and Gauger and Schroeter (1990)] and Canada [Sereletis and Robb (1986)] analyzed the relationship between money and near monies by using translog specifications of an agent's indirect utility or money service cost function. Despite some differences

1. See, e.g., Shaw (1973), Pagano (1993), King and Levine (1993) and Levine (1997, 1998).

in magnitude, the studies in general found significant substitutability between money and near-monies. Most of the previous studies have investigated either the "cross price elasticity" or "Allen elasticity of substitution" between money and near money. More recently, Sharma and Rapp (1997), Fleissig (1997), Fisher and Fleissig (1997), and Drake, Fleissig and Mullineux (1999) have utilized Morishima elasticity of substitution (MES) in their study of the U.S. and the U.K. monetary substitution. Further, Sharma and He (1997) and Sharma and Chaisrisawatsuk (2002) also estimate MES to investigate currency substitution in the U.S and in six Asian countries.

One important feature of the study by Sims et al. (1987) is the inclusion of money in the production function. Theoretical support for including money in the production function has been provided by Friedman (1959), who viewed cash held by businesses as productive resources. It determines business investment and capital formation. Gaber and Pearce (1958) refer to money simply as a "catalyst" in the production function. Also Levhari and Patinkin (1968) argued that money should be treated as a producer good as it is held to produce more output and not to generate utility. Johnson (1969) refers to money as a "form of producer's capital." Nadiri (1970) claims that if any productivity can be attributed to monetary assets then they should be included in the production function. Empirical studies supporting the inclusion of money in the production function include, among others, Sinai and Stokes (1972), Khan and Ahmad (1985), Subramanyam (1980) and Betancourt and Robles (1989).

The effects of currency substitution on macroeconomic conditions are likely to be further reinforced in a small open economy. The effects of monetary growth on the interest rate are further complicated by subsequent fluctuations in the exchange rate and capital flows. Hence, we devote this study to the investigation of elasticity of substitution between money and near monies in a small open economy-Switzerland. Towards this goal, we estimate the Morishima elasticity of substitution between five monetary assets, i.e, currency and demand deposits at commercial banks, demand deposits with the postal system, deposits on transaction accounts with banks, savings deposits, and time deposits. In addition, our empirical analysis avoids some of the criticism surrounding previous research on the subject. In applied research, even though the translog functional form is commonly used to estimate elasticity of substitution, its curvature condition can only be imposed locally (at a point) which may not be satisfied globally. However, in the symmetric generalized McFadden cost function, without destroying the flexibility property, the global concavity conditions can be imposed irrespective of the data point [Diewert and Wales (1987)]. Thus, in this study the symmetric generalized McFadden cost function is used.

The paper is organized as follows. Section 2 describes developments in the Swiss monetary policy. Section 3 outlines the relevance of elasticity of substitution to the analysis of monetary policy in Switzerland. The specification and estimation of the model is discussed in Section 4. Empirical findings are reported and analyzed in Section 5, and Section 6 concludes this study.

2. SWISS MONETARY POLICIES AND IMPORTANCE OF SUBSTITUTION ELASTICITY

In 1973, the Swiss National Bank (SNB) ceased pegging the Swiss franc to the U.S. dollar marking a significant event in the monetary history of Switzerland. During the pre-1973 fixed exchange rate period, monetary policy was mostly accommodative. The switch to a floating exchange rate in

1973 increased the effectiveness of Swiss monetary authorities in controlling the domestic money stock and thus inflation, as it was no longer committed to intervene in the foreign exchange market in support of the currency peg. During 1974-78, the design of monetary policy was driven by interest in determining inflation and output growth. Hence, the SNB established targets for narrow money, M1, based on explicit inflation targets and forecasts of potential output and velocity growth. Although exchange rate considerations led to significant short-term deviations from the projected monetary growth path, these deviations were cyclical in nature and, therefore, were neutral in the long run. Experience, however, necessitated revising the targeted monetary aggregate, M1.

Targeting M1 proved to be too narrow for the objective of monetary policy as financial developments generated a variety of instruments that could affect aggregate spending. Forecasting the multiplier for M1 proved to be inadequate to determine aggregate monetary liquidity in response to the Central Bank policy. At the end of 1978, the SNB abandoned the M1 target because of problems in forecasting the money multiplier and the strong appreciation of the Swiss franc [Rich and Beguelin (1985), Kohli and Rich (1986), Rich (1987) and Fischer and Peytrignet (1991)]. Since 1980, the target has been set in terms of the monetary base. It was felt that a base target would reduce the risk of an inappropriate response by the SNB to a change in the demand for M1, which may be induced by asset substitution. In contrast, targeting the monetary base allowed the SNB to direct monetary policy at a variety of monetary instruments that may be affected by changes in the monetary base. The monetary base remained the SNB's target variable for the subsequent two decades.

Schiltknecht (1983) and Rich (1993) have shown that the money-targeting policy in Switzerland is viewed as a medium-term to long-term constraint with the necessity for short-term flexibility in response to unexpected shifts in money demand or excessive movements in the exchange rate. Despite short-term velocity fluctuations, the early 1980s saw a relatively stable relationship between money growth and economic activity [Yue and Fluri (1991), Bernanke and Mishkin (1992)]. Although money growth targets were routinely met, the short-term volatility of money growth remained comparatively high. An intuitive explanation for this may be that monetary authorities were acting quickly to offset high frequency deviations of money growth from the target level.

The SNB relied on annual growth rates for the monetary base until the end of the 1980s. During the late 1980s, however, the performance of the monetary base as a target variable deteriorated significantly. This may be due to a structural break in the demand for base money brought about by the introduction of an electronic interbank payments system in 1987 and a reduction in legal reserve requirements in early 1988 (Yue and Fluri, 1991). Consequently, the SNB began to reconsider the potential usefulness of broader monetary aggregates, rather than the base, as indicators of monetary policy. In 1990, the SNB shifted to a looser form of monetary targeting by fixing an objective for the monetary base covering a medium term of a five-year period. This policy change provided a clear admission by the SNB that short-term fluctuations in the monetary base are bound to occur, given difficulty in estimating the demand for money and currency substitution.

The SNB implemented its monetary policy by influencing the three-month LIBOR rate, the economically most significant money market rate for Swiss franc investment. Targeting of the LIBOR rate is achieved by varying the level of reserves, which in turn, is related to the monetary aggregates.

Variations in the LIBOR rate is seen as changing long term rates on bonds via a term structure relation. Changes in the interest rate may affect the demand for financial assets, given agents' forecasts of economic conditions (output growth, price inflation, domestic policies and the exchange rate. In the presence of close substitutes for money, any attempt by the Swiss National Bank to influence a specific monetary asset would cause economic agents to shift into other monetary assets). Asset substitution may mitigate the effects of changes in the interest rate on the demand for monetary aggregates and reduce the effectiveness of monetary policy.

At the end of 1999, the SNB modified its policy approach once again and abandoned monetary targeting altogether in favor of an approach resting on the strength of inflation forecasts extending three years into the future. Once again, the policy change indicates the difficulty to determine inflation by targeting the monetary base, given the instability of the money demand function. The SNB views this policy change as necessary to increase the command of monetary policy on unexpected shocks, notably exchange rate and cyclical shocks (Rich, 2000).

The ultimate objective of the SNB's monetary policy is to maintain price stability and create a favorable environment to allow the economy to make full use of its production potential. In the long term, the price trend depends primarily on the course of the monetary aggregates. Thus, the Bank needs indicators to determine whether or not its monetary policy course is appropriate in view of the price stability goal. The relationship between monetary aggregates and inflation has, thus, been of prime importance.

3. CURRENCY SUBSTITUTION: MEASURES AND IMPLICATIONS

Our research will provide estimates of the Morishima elasticity of currency substitution in Switzerland. These estimates are important for the case of Switzerland.

First, financial innovations have increased liquidity in the Swiss economy in recent years, as a number of financial instruments have been introduced. Second, Switzerland has often been referred to as a showcase for the operation of monetarist procedures (Fischer 1993, Rich 1990). Unlike many other central banks that have experimented with monetarist rules, the Swiss National Bank (SNB) has adhered to fairly tight monetarist prescriptions. As indicated above, from 1973 to 1999, with occasional exceptions, the SNB has conducted a policy of monetary targeting. The Bank has announced, and in most cases achieved, target growth rates for a monetary aggregate. Given the experience of the SNB in monetary targeting, the elasticity measure between monetary assets needs to be estimated in order to assess the effectiveness of Swiss monetary policy during that episode. Given the degree of innovations and the wide range of new instruments, it would be of interest to see if the substitutability between money and near monies has increased in recent years.

Third, the SNB's decision at the end of 1999 to abandon monetary targeting in favor of an expected inflation target makes this study more relevant. A high elasticity of substitution between various monetary assets would justify abandoning monetary targeting in favor of inflation targeting by the SNB. Monetary targeting aimed at inducing changes in the interest rate to affect the demand for the monetary aggregate. High elasticity of substitution reduced the effects of the interest rate on money demand. Hence, changes in the interest rate may not be adequate to affect the demand for financial assets. It is, therefore, necessary to determine the direction of monetary policy based on developments in the policy objective, i.e., the inflation rate.

4. MODEL, DATA AND ESTIMATION

4.1 Model Specification

Suppose that money services are produced by the following production function:

$$y = f(m_1, m_2, \ldots, m_n, t)\,, \qquad \ldots (1)$$

Where y is real GDP, m_i is the i^{th} money input and t is the technological index representing transaction technology. The cost function, dual to the production function is given by

$$C(p, y, t) = min_m \{p'm;\ p, m \geq 0\} \qquad \ldots (2)$$

Where $m = (m_1\ m_2 \ldots m_n)'$ is the input vector with the corresponding price vector $p = (p_1, p_2 \ldots p_n)' > 0$. Note that the input prices are the rental prices of the corresponding assets. $C(\cdot)$ is assumed to be well-behaved, i.e., linearly homogenous, concave in input prices, and twice continuously differentiable.

In this study, the symmetric generalized McFadden (SGM) cost function is used, which for n inputs is given by (see Diewert and Wales, 1987, pp. 51-54),

$$C(p, y, t) = g(p)y + \sum_{i=1}^{n} b_{ii}\, p_i y + \sum_{i=1}^{n} b_i p_i + \sum_{i=1}^{n} b_{it} p_i t y + b_t(\sum_{i=1}^{n} \alpha_i p_i)t + b_{yy}(\sum_{i=1}^{n} \beta_i p_i)y^2 + b_{tt}\, t^2 y \sum_{i=1}^{n} \gamma_i p_i), \ldots (3)$$

Where,

$$g(p) = \frac{1}{2}\left(\frac{p'Sp}{\theta'p}\right) \qquad \ldots (4)$$

S is an (nxn) symmetric negative semi definite matrix with the $(i,j)^{th}$ element denoted by s_{ij}, and $\theta' = (\theta_1, \theta_2, \ldots, \theta_n) > 0$ is a vector of nonnegative constants and not all equal to zero. Diewert and Wales (1987, p. 54) showed that if the estimated S matrix is negative semi definite then the SGM cost function is globally concave in input prices. By using Shephard's lemma, the input demand equations are:

$$m_i/y = [\sum_{j=1}^{n} s_{ij} p_j / \sum_{k=1}^{n} \theta_k p_k] - \theta_i [\sum_{k=1}^{n} \sum_{j=1}^{n} p_k p_j s_{kj} / (\sum_{k=1}^{n} \theta_k p_k)^2] + b_{ii} + b_i y^{-1}$$
$$+ b_{it} t + \alpha_i t y^{-1} + \beta_i y + \gamma_i t^2\,,\ i = 1, 2, \ldots, n, \ldots (5)$$

where $s_{ij} = s_{ji}$ and $\sum_{i=1}^{n} s_{ij} = 0$ for $j = 1, 2, \ldots, n$. Following Diewert and Wales (1987), θ' is set equal to the sample mean value of the corresponding input and b_t, b_{tt}, and b_{yy} are set to unity.

Morishima (1967) and Blackorby and Russell (1989) introduced what is now known as Morishima elasticity of substitution (MES) and derived the expression for the cost function. Blackorby and Russel (1989) have pointed out that the Allen elasticity of substitution (AES) is not informative in the sense that it doesn't provide information about the relative factor shares or the curvature of the isoquant.

Moreover, it cannot be interpreted in the spirit of the marginal rate of substitution. On the other hand, the Morishima elasticity of substitution does retain the characteristics of the Hicksian concept of the elasticity of substitution for the case of two inputs. Recently, Sharma (2002a, 2002b) derives expressions for the multi-output variable profit function and for the profit function.

The Morishima elasticity of substitution measures the percentage change in the optimal (input) quantity ratio induced by a percentage change in relative (input) prices. Consider the cost minimizing input ratio m_i/m_j and the relative price p_j/p_i, holding p_i fixed, a percentage change in p_j equal to a percentage change in relative prices will affect both m_i and m_j. The Morishima elasticity of substitution (MES) can be expressed as:

$$MES_{ij}(y,p) = \varepsilon_{ij}(y,p) - \varepsilon_{jj}(y,p), \qquad i,j, = 1, 2, \ldots, n. \qquad \ldots (6)$$

Where $\varepsilon_{ij}(y,p)$ is the cross-price elasticity of demand and $\varepsilon_{jj}(y,p)$ is the own-price elasticity of demand. The i^{th} and j^{th} inputs are substitutes in the Morishima sense if $MES_{ij} > 0$, and they are Morishima complements if $MES_{ij} < 0$. It is possible that a pair of Allen complement inputs may be Morishima substitutes when more than two inputs are used in the production function. In this situation, an increase in p_j causes both m_i and m_j to fall but m_i decreases less than m_j so that the input ratio m_i/m_j rises. The fact that $\varepsilon_{ij} < 0$ implies that m_i and m_j are Allen complements. However, the two inputs are Morishima substitutes since $MES_{ij}(y,p) = \partial\ 1n(m_i/m_j) \,/\, \partial\ 1n(p_j/p_i) > 0$. The fact that the cost minimizing derived input ratio (m_i/m_j) rises as a result of an increase in relative prices (p_j/p_i), holding p_i fixed, indicates that there is some degree of substitutability between the two inputs, despite the negative cross-price elasticity of demand.

4.2 DATA

The monetary aggregates are defined in accordance with common practice among central banks. Consequently, M1 consists of highly liquid assets such as currency in circulation, demand deposits with banks, and demand deposits with the postal system. M2 consists of M1 plus savings deposits, while M3 includes M2 and time deposits. The monthly data are from January 1976 to August 1996 on five Swiss monetary assets: currency and demand deposits at commercial banks (CDDCB), demand deposits with the postal system (DDPS), deposits on transaction accounts with banks (DTAB), savings deposits (SD), and time deposits (TD), their rate of return (r_{it}), i.e. the interest rate of the ith asset, and the benchmark rate, R_t, are obtained from the Swiss National Bank. In this study, we use the three-month rate on time deposits with large banks as the time deposit rate of return. The data for consumer price index is obtained from International Financial Statistics.

Following Barnett (1978, 1980), the rental price (or user cost) of an asset is viewed as the opportunity cost of holding the i^{th} asset and is specified as:[2]

$$p_{it} = \frac{P_t(R_t - r_{it})}{1 + R_t} \qquad \ldots (7)$$

2. Our analysis of currency substitution does not account for possible exchange rate risk. Local firms have access to high-quality and diversified hedging instruments (see Obstfeld and Rogoff 1998).

where, p_{it} is the user cost of asset i at time t, r_{it} is the rate of return, or the interest rate of the i^{th} asset at time t, P_t is the consumer price index, and R_t is the benchmark rate at time t, i.e., the yield available on a "benchmark" asset that is held as a store of wealth. The benchmark data is from Yue and Fluri(1991).[3] They define that the benchmark asset is either the short-term Euro-Swiss deposits, or the long term Swiss-bond depending on which yield is higher. Thus, the benchmark rate in each period is the highest rate among the following: the short-term Euromarket-Swiss franc interest rates, the secondary market yield on cantonal bonds and the interest rates on cash certificates with the cantonal or large banks.

4.3 ESTIMATION PROCEDURE

The set of five demand equations in (5) are made stochastic by adding a random error term u_i to each equation. It is assumed that the u_i have zero mean, constant variance but are contemporaneously correlated across equations. First, the system of all five input demand equations is estimated by Zellner's seemingly unrelated regression, SUR (Zellner, 1962), procedure. The residuals indicate first order autocorrelation among errors. Thus, in the second stage each equation is corrected for first order autocorrelation, AR(1), i.e.,

$$u_{it} = \rho_i u_{it-1} + v_{it}, \qquad |\rho_i| < 1$$

And the set of corrected five share equations is estimated again by iterative seemingly unrelated regression (ITSUR) method. At this stage the concavity of the cost function was violated, (i.e., the estimated S matrix was not negative semi definite), and so concavity is imposed by reparameterizing the matrix S, i.e., (Diewert and Wales, 1987),

$$S = -AA', \qquad \text{... (8)}$$

Where $A = (a_{ij})$, $i = 1, 2 \ldots n$, and $a_{ij} = 0$ for $i < j$. In our case $n = 5$, and thus concavity is imposed by the following reparametrization:

$$s_{11} = a_{11}^2$$
$$s_{12} = -a_{11}a_{21}$$
$$s_{13} = -a_{11}a_{31}$$
$$s_{14} = -a_{11}a_{41}$$
$$s_{22} = -(a_{21}^2 + a_{22}^2)$$
$$s_{23} = -(a_{21}a_{31} + a_{22}a_{32})$$
$$s_{24} = -(a_{21}a_{41} + a_{22}a_{42})$$
$$s_{33} = -(a_{31}^2 + a_{32}^2 + a_{33}^2)$$
$$s_{34} = -(a_{31}a_{41} + a_{32}a_{42} + a_{33}a_{43})$$
$$s_{44} = -(a_{41}^2 + a_{42}^2 + a_{43}^2 + a_{44}^2).$$

3. Yue and Fluri (1991) benchmark data set was obtained from Christof Stahel at the Swiss National Bank.

The rest of the elements of matrix S are obtained by using the constraints $s_{ij} = s_{ji}$ and $\sum_{j=1}^{5} s_{ij} = 0$.

Thus, in summary, in the final stage, in the equations corrected for AR(1), s_{ij} are replaced by a_{ij} and again the system of five equations is estimated by ITSUR method. Since s_{ij} is not directly estimated their standard errors are obtained from the standard errors of a_{ij} by using the Taylor series expansion.

5. EMPIRICAL RESULTS

For completeness, the parameter estimates along with their standard errors are reported in Table 1; even though these estimates are not of much interest directly in this kind of study.

Table 1
PARAMETER ESTIMATES

Parameters	*Estimates*	*S.E.*	*Parameters*	*Estimates*	*S.E.*
s_{11}	−14.1329	2.73961	β_2	−0.0026	0.0060
s_{12}	0.3684	2.76366	γ_2	0.0000	0.0000
s_{13}	5.6151	1.06844	b_{33}	−0.1211	3.4469
s_{14}	3.4095	1.29801	b_3	180.5920	435.8388
s_{15}	4.7399	4.23907	b_{3t}	0.0035	0.0107
s_{22}	−2.2857	3.10272	α_3	0.0776	2.5039
s_{23}	−0.1610	1.16866	β_3	−0.0010	0.0069
s_{24}	0.8850	1.34862	γ_3	−0.0001	0.0000
s_{25}	1.1933	4.52208	b_{44}	−2.3076	6.1121
s_{33}	−5.7903	0.95049	b_4	358.6111	789.9626
s_{34}	0.9188	1.18737	b_{4t}	−0.0074	0.0218
s_{35}	−0.5827	2.19559	α_4	2.9012	5.2612
s_{44}	−4.7657	4.22043	β_4	0.0029	0.0120
s_{45}	−0.4477	4.76712	γ_4	0.0000	0.0000
s_{55}	−4.9028	8.12884	b_{55}	10.0241	15.1318
b	−1.8917	3.3683	b_5	−363.2901	1950.4381
b_1	300.1201	428.1631	b_{5t}	0.0521	0.0554
b_{1t}	−0.0043	0.0115	α_5	−9.5714	13.1028
α_1	1.4485	2.7420	β_5	−0.0240	0.0300
β_1	0.0032	0.0067	γ_5	−0.0001	0.0001
γ_1	0.0000	0.0000	ρ_1	0.7996	0.0420
b_{22}	1.5189	2.9869	ρ_2	0.7463	0.0465
b_2	−225.3787	377.2247	ρ_3	0.7002	0.0419
b_{2t}	0.0028	0.0096	ρ_4	0.6948	0.0317
α_2	−0.8905	2.2627	ρ_5	0.5084	0.0968

5.1 Own and Cross Price Elasticity

Table 2 presents a summary of the own and cross price elasticity of demand.

Table 2
OWN AND CROSS PRICE ELASTICITY

	Minimum	*Mean*	*Maximum*	*T-Stat*
ε_{11}	–0.4667	–0.2041	–0.1044	51.18
ε_{22}	–0.2347	–0.1360	–0.0661	52.09
ε_{33}	–0.5494	–0.2612	–0.0931	49.99
ε_{44}	–0.0878	–0.0426	–0.0206	39.28
ε_{55}	–0.2024	–0.0656	–0.0042	20.85
ε_{12}	–0.0028	0.0008	0.0116	4.56
ε_{13}	0.0338	0.1459	0.4402	26.54
ε_{14}	–0.0361	0.0103	0.0778	5.55
ε_{15}	0.0025	0.0471	0.1972	19.74
ε_{21}	–0.0308	0.0037	0.0577	3.32
ε_{23}	–0.0259	–0.0055	0.0836	4.96
ε_{24}	–0.0047	0.0632	0.1351	26.47
ε_{25}	0.0063	0.0746	0.2049	23.97
ε_{31}	0.0599	0.1626	0.3855	36.13
ε_{32}	–0.0273	–0.0039	0.0058	10.03
ε_{34}	–0.0150	0.0963	0.2462	25.59
ε_{35}	–0.0750	0.0061	0.0560	4.89
ε_{41}	–0.0202	0.0047	0.0477	6.28
ε_{42}	–0.0002	0.0034	0.0093	23.84
ε_{43}	–0.0044	0.0338	0.1077	18.23
ε_{45}	–0.0399	0.0008	0.0230	1.22
ε_{51}	0.0114	0.0492	0.1485	24.58
ε_{52}	0.0042	0.0133	0.0329	28.43
ε_{53}	–0.0179	0.0076	0.0397	8.84
ε_{54}	–0.0375	–0.0045	0.0614	3.29

1. Currency/demand deposits at commercial banks, CDDCB.
2. Demand deposits with postal system, DDPS.
3. Deposits on transaction accounts with banks, DTAB.
4. Savings deposits, SD.
5. Time deposits, TD.

To ease the discussion, the monetary assets are numbered 1 to 5, i.e., – 1. Currency/demand deposits at commercial banks, CDDCB; 2. Demand deposits with postal system, DDPS; 3. Deposits on transaction accounts with banks, DTAB; 4. Savings deposits, SD; and 5. Time deposits, TD. Two assets are substitutes if $e_{ij} > 0$ and complements if $e_{ij} < 0$.

The minimum, mean, and maximum values are reported, as well as the *t*-statistics for the null ypotheses that the mean value is equal to zero. Over the entire sample period, all of the own price lasticities are found to be consistently negative as expected and the mean values are statistically ignificant at the 5% level of significance. The elasticities indicate consistent inelastic demand for all ive assets implying that a one per cent increase in the cost of holding a particular asset leads to a ess than one per cent drop in demand for that asset. Monetary asset holdings in Switzerland are not verly responsive to changes in user costs. The least liquid accounts, SD and TD, demonstrate the ighest degree of inelasticity. Among the assets investigated, deposits on transaction account with anks (DTAB) demonstrate the lowest degree of inelasticity. The user cost elasticity of demand for DDCB ranges from –0.4667 to –0.1044 with a mean value of –0.2041. This is consistent with the ndings reported in Friedman and Schwartz (1982). Estimates for SD show the highest degree of nelasticity – ranging from –0.0878 to –0.0206 with a mean value of –0.0426. In general, the elasticities re higher for the more liquid assets.[4] The demand for liquid assets decreases in response to a higher terest rate. In contrast, changes in the interest rate may not be accompanied by a large change in e demand for less liquid assets.

It is usually argued that higher the interest elasticity of a monetary asset, the weaker is the esponse in interest rates to cyclical movements in economic activity and the inflation rate provided e central bank pursues a strategy of steady money growth. During an expansion, for example, oney demand increases and, therefore, the interest rate. Given high elasticity of M1 to a change in e interest rate, higher interest decreases money demand to a level that is consistent with the monetary rget. Cyclical movements in inflation and output growth increase absent adjustments in the interest te unless the SNB is prepared to modify its strategy of steady money growth. More specifically, the NB would have to undershoot its target of monetary growth during cyclical expansions (to allow for higher interest rate) and overshoot during cyclical contractions (to allow for a lower interest rate) in rder to moderate cyclical aggregate economic conditions. It was, therefore, a wise move that the NB abandoned targeting M1 in 1978 to maintain a monetary target (monetary base) that is less ensitive to the change in the interest rate and, therefore, SNB was able to stabilize cyclical economic onditions, while maintaining its strategy of steady monetary growth.

We observe that DDPS is a complement to DTAB throughout the entire sample period. The omplementary relationship can be attributed to the fact that deposits on transaction account with anks are primarily business accounts while DDPS are primarily household accounts. The cross rice elasticity for SD (e_{45}) and TD (e_{54}) are not consistent over the entire sample period. These lasticities are small in magnitude and vary from –0.04 to 0.02. Moreover, the mean value of e_{45} is ot statistically significant. CDDCB is found to be a substitute for each of the other four assets – DPS, DTAB, SD, and TD. Similarly, both DDPS and DTAB are found to be a substitute for each of e two savings assets –SD and TD.

4. In absolute terms; however, the elasticities are much lower than those reported for similar assets in the U.S. Fleissig and Swofford (1996) reported own elasticity of demand around one for savings deposits and higher than two for both cash and small time deposits.

5.2 Morishima Elasticity of Substitution

The Morishima elasticity of substitution represents the percentage change in the ratio of two monetary assets, m_i/m_j, when the relative price of p_i/p_j is changed in the j^{th} coordinate direction, holding p_i fixed. The effects of this variation in p_i/p_j in the j^{th} coordinate direction on the quantity ratio m_i/m_j is divided into two parts: the proportional effect on m_i of varying p_j and the proportional effect on m_j of varying p_j. The estimated MES are summarized in Table 3, which includes the minimum, mean, and maximum values as well as the *t*-statistics for the null hypotheses of the mean value equal to zero. The MES are also plotted for the entire time period in Figure 1. Asset *i* and *j* are Morishima substitutes (complements) if $MES_{ij} > 0$ ($MES_{ij} < 0$). The mean values of all the MES summarized in Table 3 are significantly different from zero.

Table 3
MORISHIMA ELASTICITY OF SUBSTITUTION

	Minimum	*Mean*	*Maximum*	*T-Stat*
MES_{12}	0.0637	0.1368	0.2449	49.47
MES_{13}	0.1303	0.4071	0.7896	50.76
MES_{14}	–0.0006	0.0530	0.1215	30.32
MES_{15}	0.0068	0.1127	0.3471	21.16
MES_{21}	0.0382	0.1397	0.2924	38.63
MES_{23}	0.0738	0.2557	0.5425	45.39
MES_{24}	0.0207	0.1058	0.1966	34.64
MES_{25}	0.0107	0.1402	0.3594	23.29
MES_{31}	0.2154	0.3668	0.7596	58.49
MES_{32}	0.0649	0.1321	0.2317	50.46
MES_{34}	0.0100	0.1389	0.2791	32.46
MES_{35}	0.0048	0.0717	0.2558	19.57
MES_{41}	0.1004	0.2088	0.4466	51.97
MES_{42}	0.0659	0.1394	0.2440	51.25
MES_{43}	0.0930	0.2950	0.5663	50.09
MES_{45}	0.0028	0.0663	0.2231	18.57
MES_{51}	0.1359	0.2534	0.5081	60.69
MES_{52}	0.0705	0.1493	0.2574	52.40
MES_{53}	0.0878	0.2688	0.5436	48.83
MES_{54}	0.0041	0.0381	0.0858	37.23

1. Currency/demand deposits at commercial banks, CDDCB.
2. Demand deposits with postal system, DDPS.
3. Deposits on transaction accounts with banks, DTAB.
4. Savings deposits, SD.
5. Time deposits, TD.

The MES for all combinations of pairs of monetary assets are positive indicating that these assets are substitutes for one another. The average MES varies from a low of 0.0381 for MES_{54} to a high of 0.4071 for MES_{13}. However, all the mean MES values, except two, are at or below 0.2688

Sims *et al* (1987) note that small elasticities of substitution allow the monetary authorities to predict fairly well the consequences of a particular policy. That is because the monetary policy can target the monetary aggregate and expected changes in the interest rate to support this target. Our results provide some explanation for the relative success of the SNB in targeting monetary aggregates in the 1970s and 1980s. From Figure 1, we note the following. MES_{12} and MES_{21} move closely together over the entire sample period. A similar close relationship is found between MES_{13} and MES_{31}. MES_{41} is consistently greater than MES_{14}. This indicates that the percentage change in the demand for currency/deposits at commercial banks relative to savings deposits tend to respond less to the change in the cost of SD than to the cost of CDDCB. MES_{15} is consistently lower than MES_{51}. The elasticities between CDDCB and DDPS as well as between DDPS and TD move closely together. The lowest bivariate elasticity is between SD and TD. MES_{45} fluctuates between 0.0028 and 0.2231, while MES_{54} fluctuates between 0.0041 and 0.0858.

Figure 1 also reveals that the nature of the relationships among the other combination of monetary assets is similar to what we have discussed earlier. The magnitude of the Morishima elasticity of substitution is less than unity in all cases. In fact, for all asset combinations, the mean elasticity is less than 0.4 mark (see Table 3).[5] However, it is consistent with the within-M1 low substitutability observed by Ewis and Fisher (1984) in the U.S. and Sereletis and Robb (1986) in Canada. Regarding the relevance of asset substitution to the design of monetary policy, several general observations can be made.

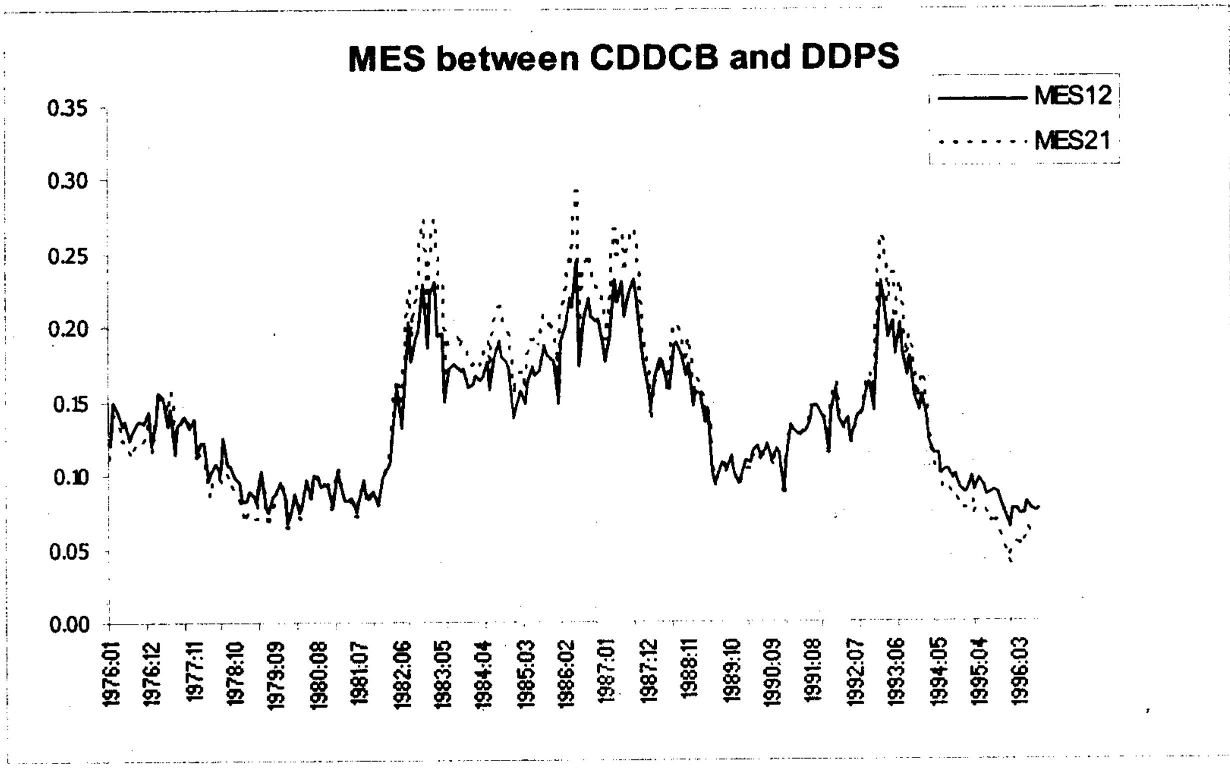
First, all monetary assets considered here are found to be substitutes for each other. This is consistent with financial development that provided agents more options to diversify their asset portfolios. This evidence supports the decision by the SNB to abandon the M1 target because of problems in forecasting the money multiplier. The latter is dependent on accuracy in forecasting money demand. High degree of substitution into less liquid monetary aggregates would render the multiplier of M1 less stable over time. Moreover, targeting this multiplier is inadequate to capture channels that may affect aggregate liquidity as economic agents find a variety of financial assets outside M1 attractive for money demand.

Second, in a number of cases the Morishima elasticity is significantly larger when adjustment takes place in the price of a relatively narrower monetary asset as compared to a broader monetary asset. Changes in the supply of a narrow monetary aggregate will be accompanied by a large substitution to other monetary assets, as the interest rate moves in response to the monetary target. Consistently, from Table 3 and Figure 1, we note that the elasticity of substitution between time deposits and saving deposits is low while the elasticity between each of these broad assets and the other narrower assets is high. This is consistent with the fact that both SD and TD are held more for their interest earning features. Hence SD and TD are important vehicles through which the portfolio redistribution impacts occur.

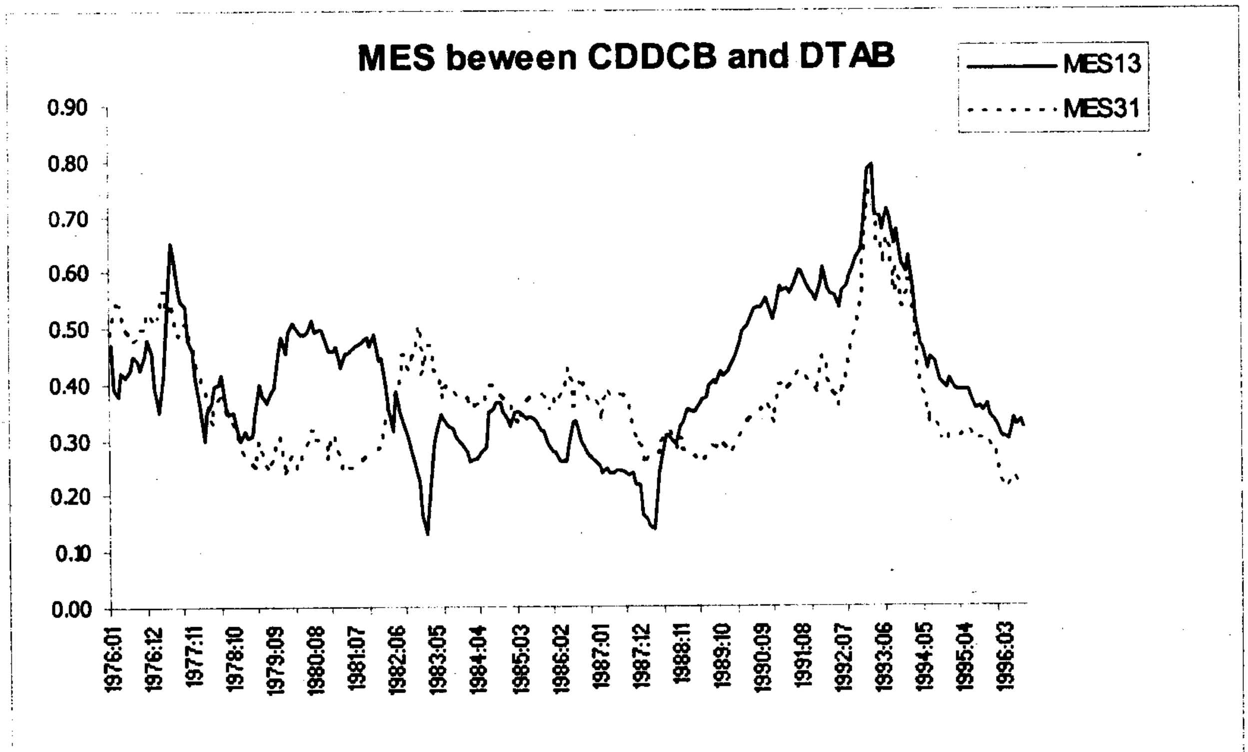
Third, volatility in the elasticity is, in general, higher when adjustment takes place in the price of a relatively narrower monetary asset as compared to a broader asset. Given competing alternatives,

5. This is significantly less than the similar elasticity reported for the United Kingdom (Drake *et al*, 1999).

Figure 1: Morishima Elasticities of Substitution



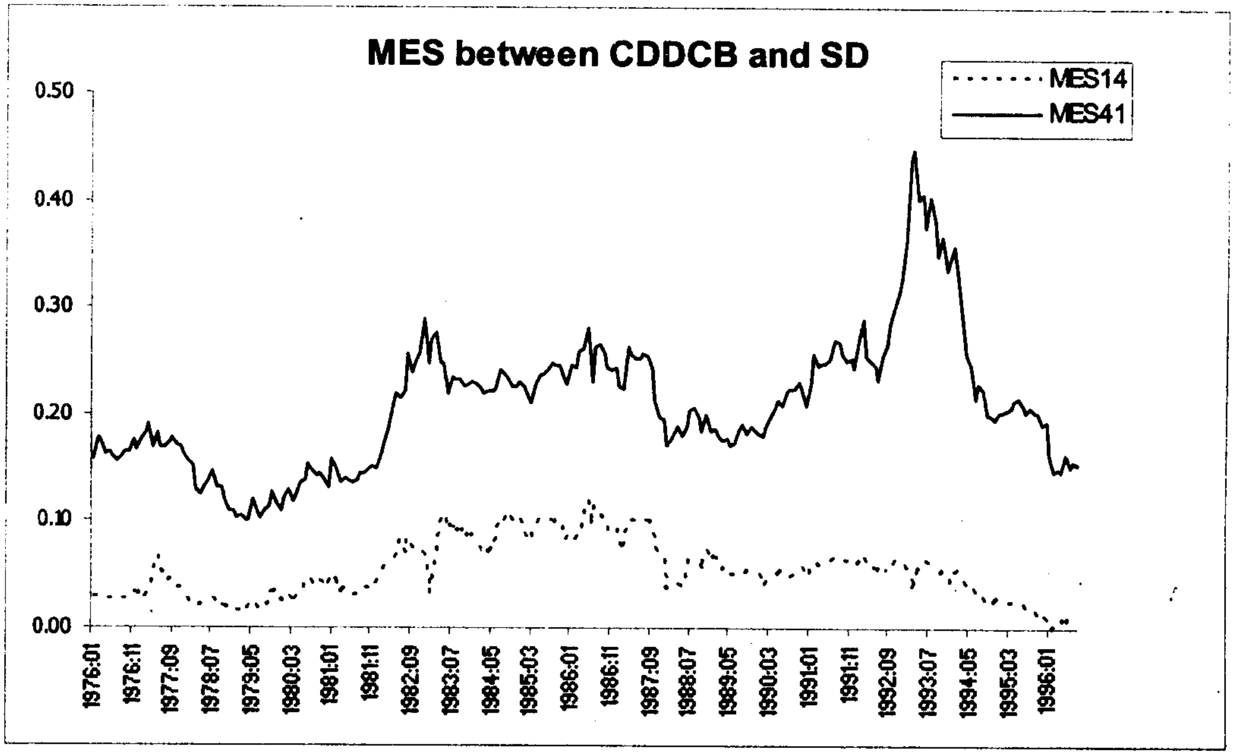
(a)



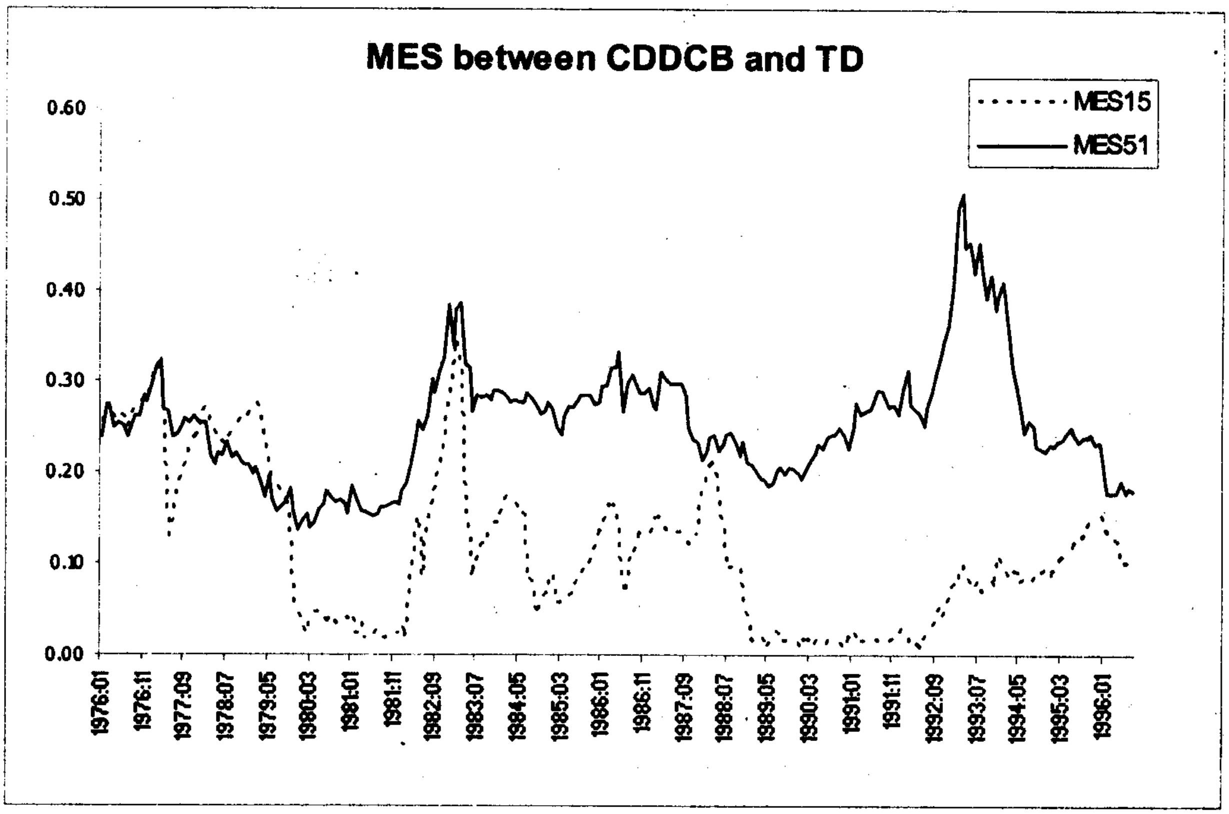
(b)

Note: 1: Currency/demand deposit at commercial banks, CDDCB;
2: Demand deposits with postal system, DDPS;
3: Deposits on transaction accounts with banks, DTAB.

Figure 1 (continued)



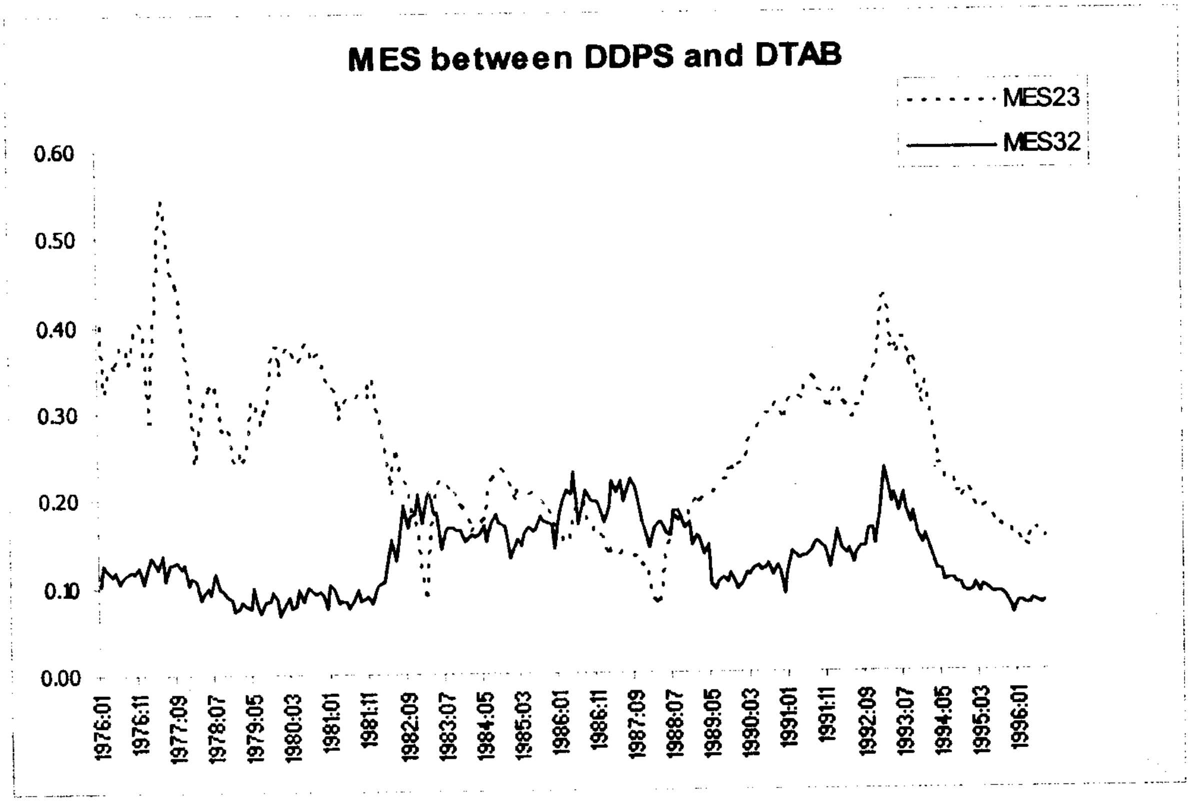
(c)



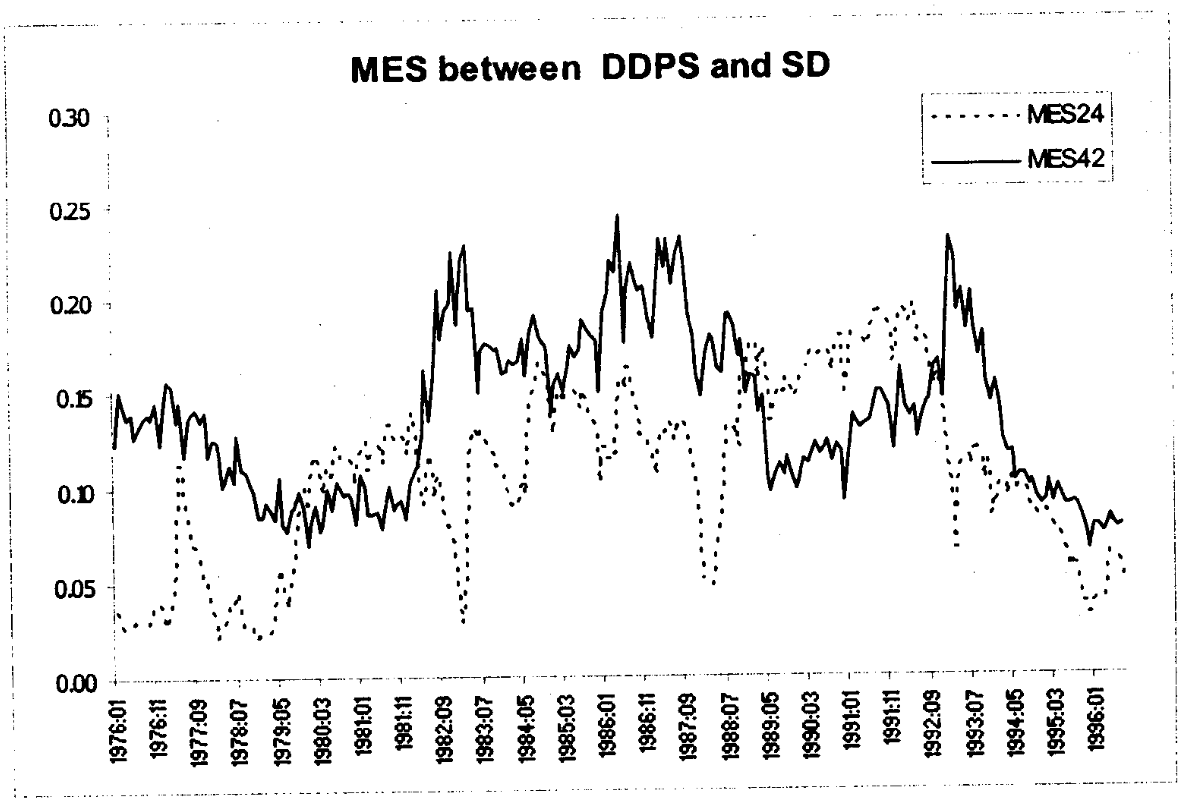
(d)

Note: 1: Currency/demand deposit at commercial banks, CDDCB;
4: Saving Deposits, SD;
5: Time Deposits, TD.

Figure 1 (continued)



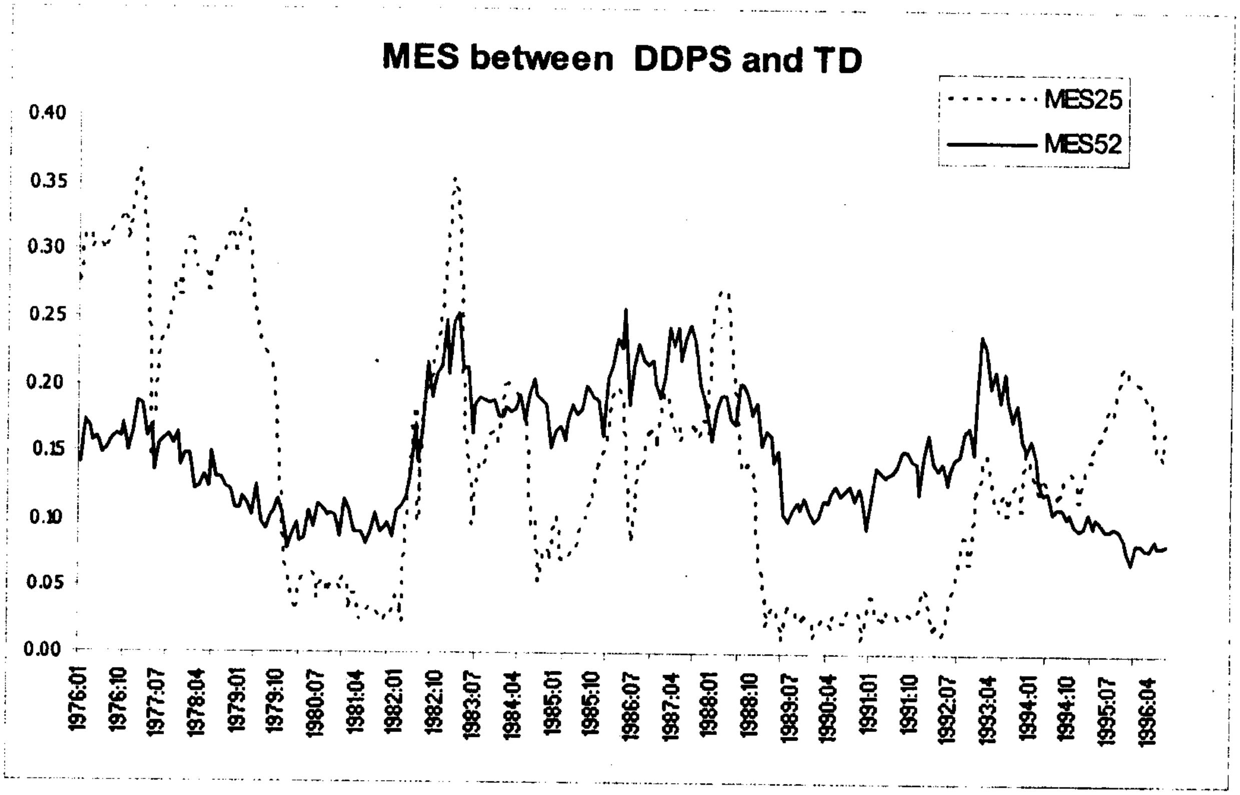
(e)



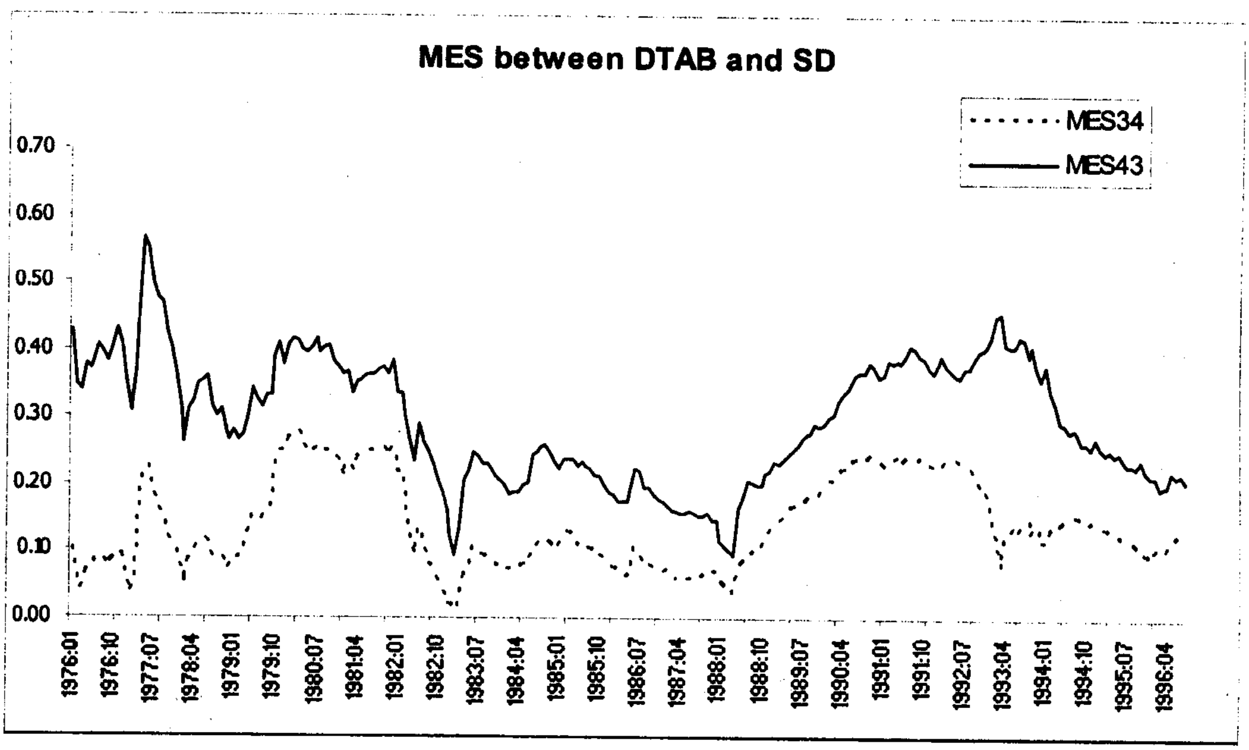
(f)

Note: 2: Demand deposits with postal system, DDPS;
3: Deposits on transaction accounts with banks, DTAB.
4: Saving Deposits, SD

Figure 1 (continued)



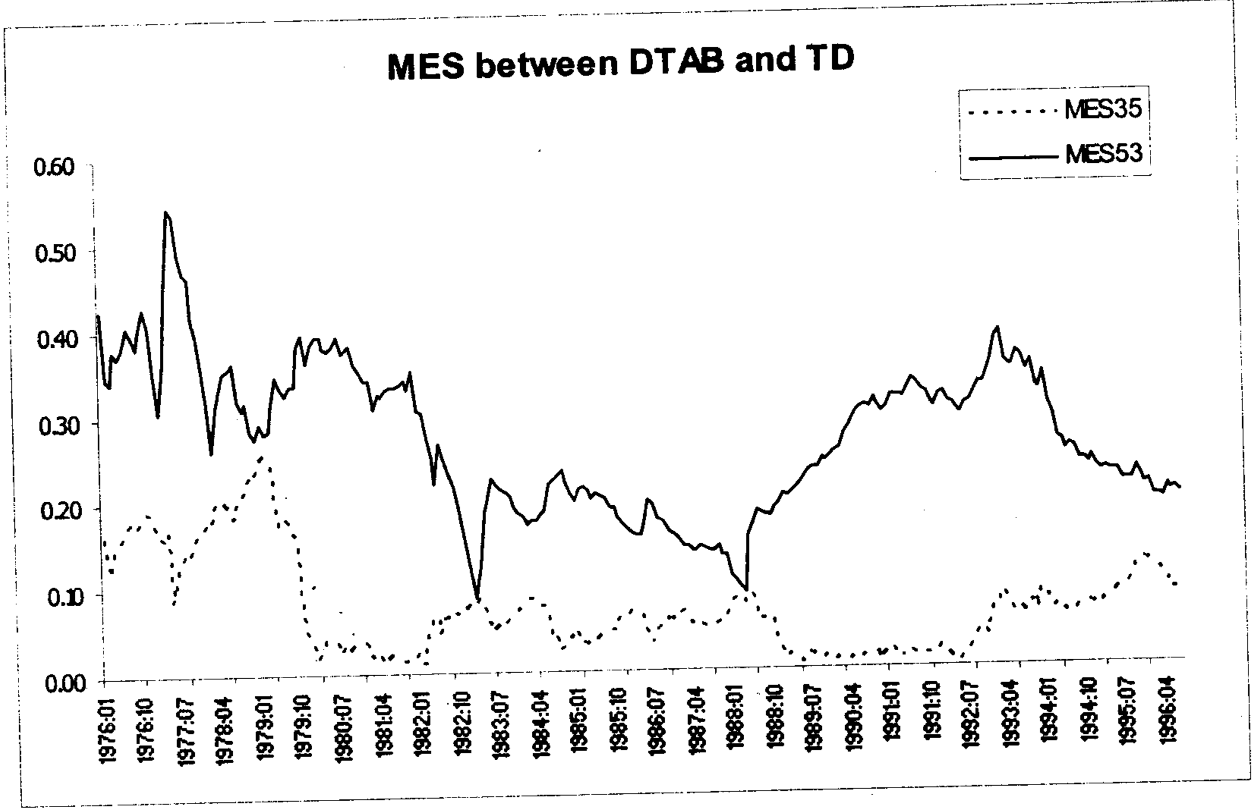
(g)



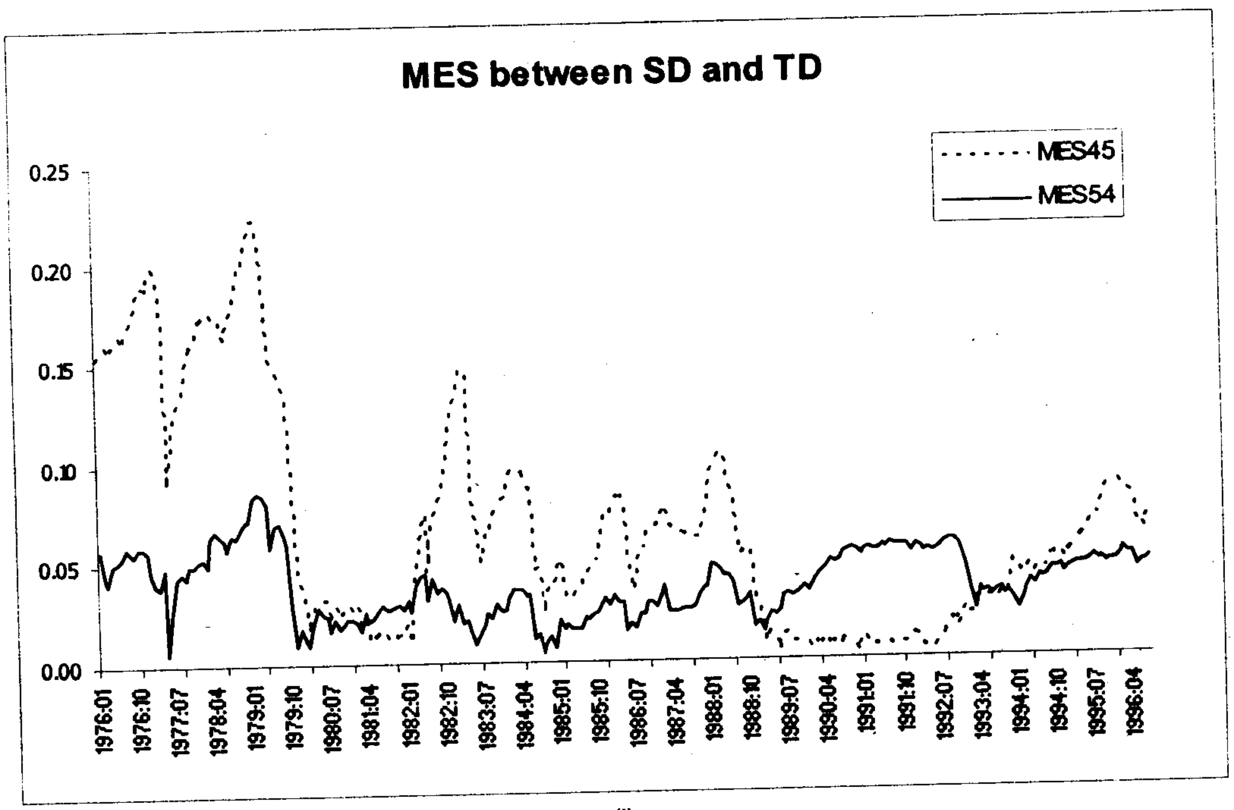
(h)

Note: 2: Demand deposits with postal system, DDPS;
3: Deposits on transaction accounts with banks, DTAB.
4: Saving Deposits, SD;
5: Time Deposits, TD

Figure 1 (continued)



(i)



(j)

Note: 3: Deposits on transaction accounts with banks, DTAB.
4: Saving Deposits, SD;
5: Time Deposits, TD

changes in the price of a narrow asset will generate demand across a number of less liquid assets. In contrast, price changes for broader assets are associated with more stable elasticity of substitution for the narrower monetary assets. Narrow money is usually demanded for transactions and, therefore, less affected by speculative demand for money.

This evidence explains the difficulty that the SNB experienced in targeting the annual growth rates for the monetary base during the late 1980s. A structural break in the demand for base money was brought about by the introduction of an electronic interbank payments system in 1987. This system increased the usefulness of broader monetary aggregates that contribute to aggregate liquidity as indicators of monetary policy. The switch to a looser form of monetary targeting in 1990 was a clear admission by the SNB that short-term fluctuations in the monetary base are bound to occur, given difficulty in estimating the demand for money and asset substitution. Accordingly, the SNB implemented its monetary policy by influencing the three-month LIBOR rate which may affect the demand for financial assets.

Fourth, in almost all cases, the fluctuations in the magnitude of elasticities are more evident in the early period, particularly in the 1970s, than in the 1980s. As more financial options became available over time, competing assets generated continuous adjustment in agents' portfolio, which jeopardized the stability of the money demand function. Failure to predict the money demand function accurately led to erroneous judgment regarding the stance of monetary policy. Subsequently, at the end of 1999, the SNB modified its policy altogether in favor of an approach of inflation targeting.

6. CONCLUSION

Over the past decade, Switzerland's central bank has been amongst the most successful in delivering on the commitment to price stability. The success of monetary policy is dependent on ability to set policy objectives and control targets. To evaluate monetary policy effectiveness, it is necessary to evaluate the stability of the money-demand function. Financial development has generated a wide range of monetary assets. The degree of substitutability between different monetary aggregates is, therefore, a necessary component to evaluate the stability of money demand and the desirability of a given target for monetary policy. The effectiveness of monetary policy is likely to be jeopardized if the monetary target is easily characterized by a high degree of substitutability in agents' assets' portfolio. A high degree of substitution in agents' assets portfolio decreases the sensitivity of money demand to a change in the interest rate, reducing the effectiveness of monetary policy in targeting aggregate liquidity and, in turn, economic activity.

Recent financial developments have generated a growing interest in analyzing their effects on the design of monetary policy. In this context, the question of substitutability between money and near monies has been explored mainly in terms of portfolio models of private sector asset holding [Chetty (1969), Boughton (1981), Husted and Rush (1984), and Ewis and Fisher (1984), among others]. Central to the measurement of the degree of substitution is the relationship between stocks of particular assets and their rates of return.

In this paper, we estimate the Morishima elasticity of substitution between five monetary assets in Switzerland. Results show that the various monetary assets are substitutes for one another.

Moreover, the Morishima elasticity is significantly larger when adjustment takes place in the price of a relatively narrower monetary asset as compared with a broader monetary asset.

We evaluate the implications of the evidence for the conduct of monetary policy in Switzerland. On the one hand, the estimated elasticity of substitution indicates that financial development provided agents more options to diversify their assets. Changes in the interest rate induced large substitution between financial assets and jeopardized the stability of money demand. As more financial options became available to substitute for M1 in portfolio balances, targeting a narrow monetary aggregate proved to be ineffective to capture channels that may affect aggregate liquidity. Accordingly, the SNB switched to targeting the monetary base in 1978.

Higher elasticity of substitution among financial assets continued to exercise pressure on the interest rate. Subsequently, the SNB switched to a looser form of monetary targeting in 1990. Under this regime, short-term fluctuations in the monetary base were permissible given difficulty to estimate the demand for money and asset substitution.

As the SNB realized the importance of the interest rate for currency substitution, the SNB implemented its monetary policy by influencing the three-month LIBOR rate to affect the demand for financial assets. Nonetheless, as more financial options became available over time, failure to predict the money demand function accurately led to erroneous judgment regarding the stance of monetary policy. Moreover, high elasticity of asset substitution reduced the effects of the interest rate on money demand. It became, therefore, necessary to determine the direction of monetary policy based on developments in the policy objective, i.e., the inflation rate. Subsequently, at the end of 1999, the SNB modified its policy approach once again and abandoned monetary targeting altogether in favor of an approach resting on the strength of inflation forecasts extending three years into the future.

The Swiss experience offers important lessons that may continue to remain pertinent in a world dominated by inflation targeting. The ultimate objective of the SNB's monetary policy is to maintain price stability and create a favorable environment for the economy to realize its production potential. To that end, knowledge of the degree of asset substitution would guide the monetary authorities to extract relevant information on the relationship between monetary aggregates and the policy objectives, i.e., output growth and price stability. Future research should explore how measures of asset substitution can be useful to forecast the money multiplier and the appropriateness of the monetary policy targets.

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