Monetary determinants of the Swiss franc

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2009-16

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ISSN 1660-7716 (printed version)
ISSN 1660-7724 (online version)

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December 16, 2009

Abstract

This paper looks into the determinants of the Swiss franc exchange rate against the euro. Based on the monetary approach to exchange rates, we start from the premise that monetary policy has an influence on the exchange rate. To measure this effect, we apply the structural vector-autoregression methodology on a set of Swiss macroeconomic variables and the euro area interest rate. Overall, we find that Swiss monetary policy contributes between 7 and 15% to variations of the exchange rate between 1981 and 2008. Focusing on the episode between 2003 and 2005 we attribute more than half of the depreciation of the franc to Swiss monetary policy.

JEL classification: E52, F31, C32.

Keywords: exchange rates, monetary policy, structural VAR models.

*Many thanks to Michael King, Michel Peytrignet, and an anonymous referee for useful suggestions. We also thank the participants at the SNB Board Symposium in Zürich (March 2008), the SNB-IMF Conference on Exchange Rates in Zürich (November 2008), and the Meeting of the "Ausschuss für Geldtheorie and Geldpolitik des Verein für Socialpolitik" in Frankfurt (February 2009) for clarifying discussions. The views expressed in this paper are those of the authors and do not necessarily represent those of the Swiss National Bank.

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1. Introduction

This paper looks into the determinants of the exchange rate and asks the following question: How does Swiss monetary policy contribute to movements in the Swiss franc vis-à-vis the euro? To answer this question we rely on the intuitive notion that the nominal exchange rate is the relative price of two currencies. Given that monetary policy determines the value of a currency, it must have an influence on the nominal exchange rate. This is the central idea behind the monetary approach to exchange rates.

However, the monetary approach does not imply that monetary factors are the only driving forces of exchange rates; rather it states that exchange rates are linked to fundamentals.[1] Macroeconomic variables like money, interest rates, real output, the price level, etc. have a potential effect on movements in the nominal exchange rate. We take this as the starting point for our analysis and study the relationship between a set of macroeconomic variables and the exchange rate. This may seem a bold venture as the empirical literature has not been very successful at explaining or forecasting exchange rates with observable macroeconomic variables. Frankel and Rose (1995) conclude in the *Handbook of International Economics*: "...we, like much of the profession, are doubtful of the value of further time-series modelling of exchange rates at high or medium frequencies using macroeconomic models."

The difficulty in forecasting floating exchange rates has been effectively demonstrated by Meese and Rogoff (1983), who showed that structural models do not outperform a random walk in forecasting monthly exchange rates. However, the fact that exchange rates are difficult to forecast does not imply that there is no link between macroeconomic fundamentals and the foreign exchange market. Being an asset price, the exchange rate is forward looking and expectations about future values of macroeconomic fundamentals have an influence on its current value. Hence, news influencing the expectations about macroeconomic variables has an immediate impact on the exchange rate. Since news (or a change in expectations) is hard to observe, it is difficult to establish the short-run empirical link between macroeconomic variables and the exchange rate. This argument is put forward by Engel and West (2005), who show analytically that models based on macroeconomic fundamentals might well result in exchange rate behaviour which is empirically indistinguishable from a random walk.

In addition to this analytical argument there are some recent empirical studies who find evidence for the connection between changes in expectations about macroeconomic variables and short-run movements in the exchange rate. Engel et al. (2007) summarise this literature and demonstrate that using surveys to measure expectations improves the forecasting ability of the monetary model. Focusing on a somewhat dif-

[1] This is the message from the original articles by Frenkel (1976) and Mussa (1976). Some authors see it differently and describe the monetary approach by attributing all movements in the exchange rate to money shocks.

ferent point, Molodtsova et al. (2008) use real-time data and demonstrate that variables which usually enter interest-rate-setting rules predict the US dollar/euro exchange rate. They conclude that real-time data is more appropriate to forecast exchange rates than revised data, because it captures the news driving the exchange rate.

Another strand of the literature has exploited the recent advances in panel cointegration methods to establish stable long-run relationships between nominal exchange rates and monetary fundamentals. Using this approach, Groen (2000) and Mark and Sul (2001) find that they can beat the random walk in forecasting nominal exchange rates using the monetary model. More recently but using a similar approach, Cerra and Saxena (2008) study a broad panel of 98 countries and conclude that there are strong links between exchange rates and monetary fundamentals based on out-of-sample forecasting results.

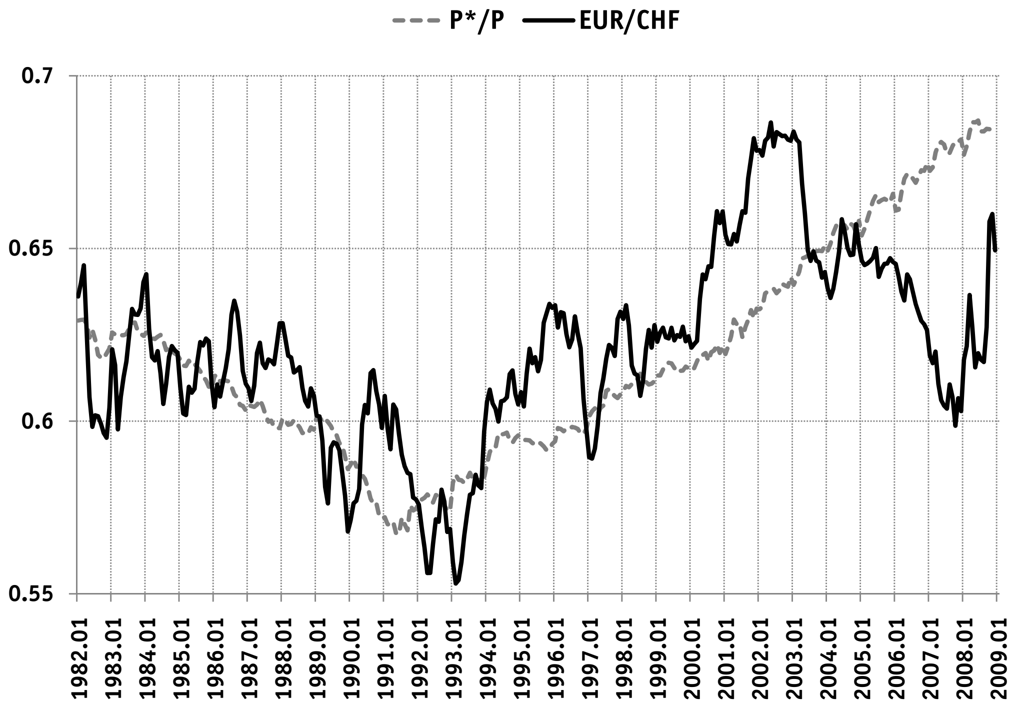
This paper does not attempt to forecast the exchange rate, its focus is rather on assessing the relative importance of Swiss monetary policy shocks for the movements of the euro/Swiss franc exchange rate. It is therefore related to work in the spirit of Faust and Rogers (2003) and the literature cited therein, which tries to identify monetary policy shocks in a small open economy using the structural vector-autoregression (SVAR) framework. Typical questions regarding the influence of monetary policy on the exchange rate in this context concern the shape of the impulse response function, the relative contribution of monetary policy to the variability of the exchange rate, or the size of possible deviations from uncovered interest rate parity (UIP). We add to this literature by setting up an SVAR model using Swiss macroeconomic variables and the euro area interest rate. We identify monetary policy shocks using a combination of short- and long-run restrictions and study their influence on the euro/Swiss franc exchange rate. Our main contribution is a detailed event study of exchange rate movements and their driving forces. In particular, we provide an ex-post explanation of the depreciation of the Swiss franc against the euro from 2003 to 2008 using a historical decomposition of the exchange rate into monetary policy and other shocks. We find that the relatively loose monetary stance from 2003 to 2005 contributed substantially to the weakness of the Swiss franc during this episode. However, since 2006 the effects of monetary policy on the exchange rate have diminished substantially, most of the variation in the Swiss franc-euro exchange rate is explained by non-monetary factors.

The rest of the paper is organised as follows: Section 2 presents a short overview of the monetary approach to exchange rates. Then, we discuss some issues about measuring monetary policy in small open economies in Section 3 and outline our identification strategy in Section 4. The empirical results on the driving forces behind the Swiss franc movements are the subject of Section 5. In Section 6 we study the influence of monetary policy for the large swings of the Swiss franc against the euro between 2003 and 2008. Finally, Section 7 draws some conclusions.

2. The monetary approach to exchange rates

When Frenkel (1976) and Mussa (1976) formulated the monetary theory of exchange rates, they stressed the importance of money as the cause of both, movements in the price level and the nominal exchange rate. They observed that to understand the relationship between exchange rates and prices, the common driving forces need to be identified. To illustrate this point Frenkel (1976) studied the German hyperinflation of the 1920s and argues that the close co-movement between the exchange rate and the price level is clearly driven by an excessive supply of money. This observation is the central building block of the monetary approach to exchange rates: Money growth (relative to real output growth) in both countries is an important driver of nominal exchange rate movements. A similar argument holds for the price levels and implies, that the exchange rate and the relative price level follow the same long-run trend when driven by monetary forces. This is best seen when inflation differentials are sizeable. In environments with lower inflation rates, the co-movement between the relative price level and the exchange rate is less pronounced than during hyperinflationary periods. An example is given in Figure 1 which shows the relative price level and the exchange rate for Switzerland and the euro area since 1982[2].

Figure 1: The long-run trend of relative price levels and the exchange rate



[2]Prior to the introduction of the euro in 1999, the German price level and the German mark-Swiss franc exchange rate are used.

Both series follow approximately the same long-run trend and, according to the monetary approach to exchange rates, this trend is basically determined by monetary policy in Switzerland and the euro area. The development of the relative price level shows that inflation has been relatively high in Switzerland until 1991, thereafter the Swiss National Bank (SNB) managed to keep inflation lower than in the euro area. We also observe strong temporary deviations of the exchange rate from the relative price level, which deserve a more detailed explanation of the transmission mechanism and the role of expectations.

Regarding expectations, Mussa (1976) stressed that "...the relative prices of national monies are determined by forces which are similar to those which operate on any asset market." As for any asset, expectations about future returns are crucial to determine current prices. In the case of the foreign exchange market, it is the expectation about the future monetary policies in both involved countries that plays a major role for current exchange rate movements. With respect to the transmission mechanism of monetary policy, Dornbusch (1976) focuses on the role of sticky prices to explain the high volatility of exchange rates compared to relative price levels. His overshooting model predicts the following reaction to a monetary easing: In the short run, the liquidity effect implies that home interest rates fall, relative to foreign interest rates. To compensate for the low domestic interest rate, UIP requires that the home currency is expected to appreciate. On the other hand, the long-run link between the price level and the exchange rate implies that loosening the monetary stance will lead to a long-run weakening of the home currency. In order to be able to appreciate to a depreciated value, the exchange rate must jump initially and therefore overshoots the long-run level.

In spite of its appealing theoretical underpinnings, the monetary approach to exchange rates has suffered serious blows from the empirical literature. Two main cases have been made against the idea that money is an important driver of the exchange rate. First, starting with Meese and Rogoff (1983) a large body of literature has demonstrated that monetary or real fundamentals, do not improve exchange rate forecasts. This does not invalidate the monetary approach, it rather says that observable macroeconomic fundamentals have no predictive power. Nevertheless, it might still be the case that the exchange rate is driven by monetary policy shocks or other unobservables. The second case is the so-called PPP-Puzzle. As Rogoff (1996) argues in his assessment of the literature on PPP, the slow adjustment of real exchange rates requires implausible assumptions about price stickiness if monetary shocks are the main driver of nominal exchange rates. This is a strong argument because despite the difficulties in assessing the stationarity of real exchange rates empirically, many studies covering different time periods and currencies share the finding of very slow mean reversion.

It is important to note that the monetary approach to exchange rates does not rely on the assumption of relative PPP. In particular, it is not inconsistent with persistent or even permanent movements of the real exchange rate. Rather, the monetary approach claims that monetary policy shocks in both countries should not affect the long-run level of the real exchange rate because that is determined by real factors. This neutrality property is not a distinguishing feature of the monetary approach but holds for many models in international finance like Obstfeld (1985) or Clarida and Galí (1994).

Summing up, our view is that the monetary approach in its sticky price version makes three points: First, money, or more precisely, expectations about monetary policy play an important role in explaining exchange rate fluctuations. Second, the exchange rate responds more quickly and more strongly to monetary policy shocks than the price level because of sticky prices. However – this is the third point – in the long run the exchange rate and the price level move by the same amount in response to a monetary policy shock.

3. Measuring monetary policy

Structural vector autoregressions (SVARs) have been the most popular tool for measuring monetary policy over the past years.[3] An important advantage of this type of model is that the variables which are of interest for monetary policy can be represented compactly and without imposing more structure than necessary. Following this principle, Bernanke and Blinder (1992) were the first to use the policy instrument together with other macroeconomic variables in an SVAR model in order to measure monetary policy. Their approach has been applied in many different variants and for different countries with the main objective of separating monetary policy shocks from systematic reactions of monetary policy to changes in macroeconomic conditions. The typical strategy to identify monetary policy shocks in this context was to assume that the policy variable reacts contemporaneously to the non-policy variables, i.e. the other variables in the system, whereas the non-policy variables react only with a lag to the policy variable. This recursive structure makes sense as long as the set of non-policy variables does not contain stock prices, exchange rates or similar variables which are supposed to react immediately to monetary policy shocks.

Whereas the early SVAR models were mostly applied to closed economies, it soon became clear that their specifications were not well suited for measuring monetary policy in open economies because they produced implausible results like the prize or liquidity puzzles. Their main deficiency was that they did not take into account the fact that the central banks of small open economies not only react to domestic but also to foreign variables, in particular the exchange rate. Taking into account this consideration, Cushman and Zha (1997) introduced an SVAR model for Canada which included US variables. In order to overcome the estimation problems posed by the increased number of variables, they assumed that Canada takes US economic conditions as given or exogenous, which seems reasonable, given the relative sizes of the two economies.

[3]Other attempts to measure monetary policy include the narrative approach by Romer and Romer (1998) or using interest rate futures on overnight funds by Rudebusch (1998).

Following this reasoning, it has become common practice to include foreign variables in SVAR models which attempt to measure domestic monetary policy shocks in small open economies. Different variable sets have been used to complement the set of domestic variables, but most authors seem to agree about including at least a short term interest rate and the exchange rate as in Smets (1997), Kim and Roubini (2000), Faust and Rogers (2003), or Artis and Ehrmann (2006). The introduction of the exchange rate in a small open economy SVAR model presents the challenge that the identification strategy has to allow for simultaneity between the domestic interest rate and the exchange rate. It is not credible to assume that either of these variables does not react to changes in the other within a month or even a quarter. This is particularly true in the present case where we want to assess the reaction of the exchange rate to monetary policy shocks. Restricting the short-run interaction between these two variables is likely to lead to misleading results. We present a possible solution to this problem in the next section.

4. Structural Identification

Our identification strategy is based on the idea of Artis and Ehrmann (2006) and consists of setting up an SVAR model for Switzerland with the following five variables: Swiss real output (y), the Swiss franc 3M-Libor (i), Swiss inflation (π), the 3M-Euribor (i^*), and the exchange rate in euros per Swiss franc (e). A similar variable set has recently been used by Bjørnland (2008) for Norway with the only difference that she replaces the nominal with the real exchange rate. We collect these macroeconomic variables in the vector $x_t = [\Delta y_t,\ i_t^*,\ \pi_t,\ \Delta e_t,\ i_t]'$ and set up the VAR model

(1) $\quad x_t = B(L)x_{t-1} + u_t,$

where $B(L) = B_1 + \ldots + B_p L^{p-1}$ is a polynomial in the lag-operator and u_t is a 5×1 vector of reduced form disturbances with covariance matrix Ω. Assuming x_t to be invertible, it can be represented as a vector moving average (VMA):

(2) $\quad x_t = D(L)u_t,$

where $D(L) = \sum_{i=0}^{\infty} D_i L^i$.

Following the usual approach in the literature, the structural form of (2) is obtained by replacing the reduced form disturbances u_t with a linear combination of the structural shocks ε_t:

(3) $\quad x_t = D(L)C_0\varepsilon_t.$

As D_0 is the identity matrix, C_0 represents the contemporaneous effects of the structural shocks on the variables in x_t. The lagged effects, that is the impulse response functions, are given by $C_i = D_i C_0$. In order to identify the structural model we first estimate the reduced form VAR which yields estimates for $B(L)$, Ω and $D(L) = (I - B(L)L)^{-1}$.

Second, we impose 25 restrictions on the elements of C_0 which allows the calculation of the structural form according to (3).

Assuming uncorrelated structural shocks with unit variance implies $C_0 C_0' = \Omega$ and yields 15 restrictions. The 10 additional restrictions are placed on the contemporaneous and long-run effects of the structural shocks. To this end it is useful to have a meaningful interpretation for all structural shocks, even though we are mainly interested in the monetary policy shock. In accordance with the suggestion by Artis and Ehrmann (2006), we attach the following labels to the structural shocks: $\varepsilon_t = [\varepsilon_t^s, \varepsilon_t^d, \varepsilon_t^{m^*}, \varepsilon_t^e, \varepsilon_t^m]'$, where the superscripts denote a supply, a demand, a foreign money, an exchange rate, and a home money shock.

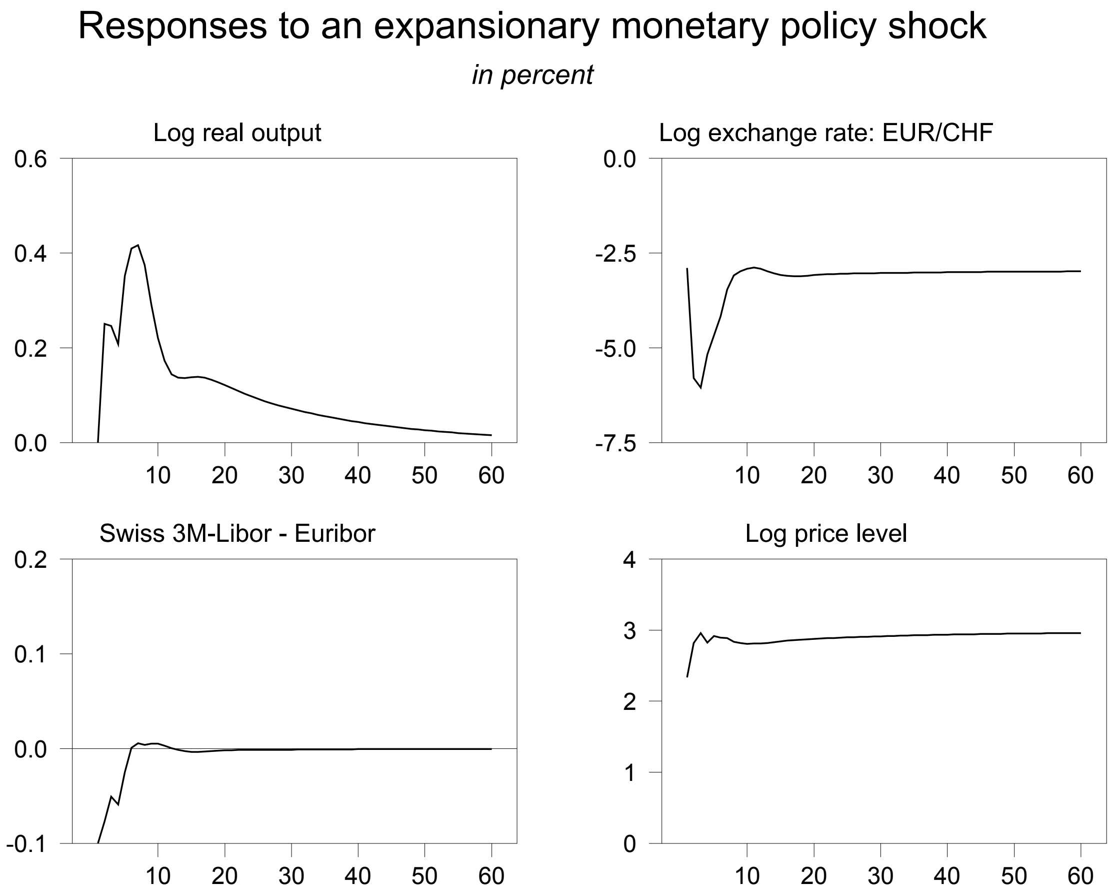
We identify the supply shock, as the only shock which has a permanent effect on Swiss real GDP, this yields four long-run restrictions. Then, we impose three additional restrictions which separate the demand shock from the other shocks with only temporary effects on real GDP. This is done assuming that the demand shock is the only of these which can contemporaneously affect real GDP. The next two restrictions state that the 3M-Euribor does not react immediately to exchange rate or Swiss monetary shocks and identifies the euro area monetary policy. Supposing that the 3M-Euribor reflects at least to some extent the actions of the ECB, this means on the one hand that the ECB does probably not care very much about the euro/Swiss franc exchange rate or Swiss monetary policy shocks. On the other hand, it implies that the ECB reacts immediately to supply and demand shocks. This makes sense given that supply and demand shocks affecting Switzerland are most likely the same shocks affecting the surrounding countries at the same time. Finally, we need one additional restriction to separate the exchange rate from the Swiss monetary policy shock. Given the arguments brought forward in the preceding section, assuming a recursive ordering between the 3M-Libor and the exchange rate is not feasible. In order to identify the monetary policy shock, we therefore assume that its long-run effect on the exchange rate and the price level is identical in absolute value. This is in line with the monetary approach to the exchange rate: A monetary expansion in Switzerland increases the Swiss price level and depreciates the Swiss franc by the same amount without affecting the euro area price level; this leaves the real exchange rate unchanged in the long run. Summing up, these restrictions can be compactly written as follows:

$$(4) \quad C_0 = \begin{bmatrix} \cdot & \cdot & 0 & 0 & 0 \\ \cdot & \cdot & \cdot & 0 & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \end{bmatrix} \qquad \sum_{i=0}^{\infty} D_i C_0 = \begin{bmatrix} \cdot & 0 & 0 & 0 & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & z \\ \cdot & \cdot & \cdot & \cdot & -z \\ \cdot & \cdot & \cdot & \cdot & \cdot \end{bmatrix},$$

where z is an arbitrary number representing the long-run effect of the monetary shock on the price level and the nominal exchange rate in absolute value. The nine zero restrictions are the same as those imposed by Artis and Ehrmann (2006), the tenth restriction is very similar to the one used by Bjørnland (2008).

We estimate (1) with monthly data covering February 1981 to September 2008 and including four lags. Applying the above identification procedure yields the responses of all variables to a one-standard-deviation shock. Figure 2 shows the responses to an expansive monetary policy shock in Switzerland which seems correctly identified as it has the expected effects: A temporary increase of real output, a short-run liquidity effect in Switzerland, a depreciation of the Swiss franc with a short-run undershooting, and a permanent increase in the price level. Note that the undershooting of the nominal exchange rate is slightly delayed, the maximum depreciation is attained after one month. The price level reacts strongly on impact, which indicates that price flexibility, at least with respect to monetary policy shocks, is quite high.

Figure 2: Impulse response functions



Because we are mainly interested in the correct identification of the monetary policy shocks we do not present the responses to the other shocks. However, it might be noted that the labels we gave them are mostly reasonable given their overall effects on the considered variables. It is also worth pointing out that the monetary policy shocks are the only shocks with a substantial permanent effect on both, the price level and the exchange rate. This implies that monetary policy is the only common driver of these two variables in the long-run.

5. The contribution of monetary policy shocks to exchange rate changes

To assess the relative contribution of the considered shocks to the volatility of exchange rate changes we present the corresponding variance decomposition in Table 1. Again we are not particularly interested in the detailed contribution of the other shocks, but we note that our an exchange rate shock explains by far most of the variance of exchange rate changes. The monetary policy shock explains about 7% percent of the long-run exchange rate variance. Focusing on the short-run we see that this contribution reaches a maximum of about 15% at the 3 month horizon. This relatively small contribution of monetary policy shocks to exchange rate movements is in line with the PPP-Puzzle: If exchange rate shocks, which have only a small influence on prices, are an important driver of the nominal exchange rate, real and nominal exchange rates must move closely together.

Table 1: Variance decomposition of euro/Swiss franc exchange rate change

	Contribution of				
Horizon	ε^s	ε^d	ε^{m^*}	ε^e	ε^m
1	9.10	7.12	10.66	66.36	6.77
2	5.61	5.12	5.61	70.78	12.87
3	3.86	3.96	3.61	73.60	14.96
6	2.64	2.20	2.19	79.75	13.22
12	2.86	1.28	1.28	84.76	9.82
24	2.83	0.69	1.14	87.28	8.06
36	2.52	0.59	1.17	88.30	7.41
60	1.85	0.99	0.98	89.30	6.88

A different way of assessing the relative importance of monetary policy shocks for exchange rate movements can be obtained from the historical decomposition. We focus on the annual percentage changes of the exchange rate because we are interested in the contribution of the medium term monetary policy stance to exchange rate movements rather than that of single monetary policy shocks. Given the VMA representation of the exchange rate changes

(5) $$\Delta e_t = c(L)\varepsilon_t,$$

where $c(L)$ is the fourth row of $D(L)C_0$ in (3), we can compute the corresponding VMA representation for the annual rate of change:

(6) $$\Delta_{12} e_t = c_0\varepsilon_t + (c_0 + c_1)\varepsilon_{t-1} + \ldots + (c_0 + \ldots + c_{11})\varepsilon_{t-11} + (c_1 + \ldots + c_{12})\varepsilon_{t-12} + \ldots$$

According to the impulse response function it takes about 12 months for the monetary policy shocks to develop their full effect on the exchange rate. We therefore truncate the VMA representation (6) after 12 lags which yields the approximation:

(7) $\Delta_{12} e_t \simeq \gamma_{12}(L) \varepsilon_t,$

where $\gamma_{12}(L) = c_0 + (c_0 + c_1)L + \ldots + (c_0 + \ldots + c_{11})L^{11}$. Decomposing the vector of structural shocks between ε_t into the monetary policy shock ε_t^m and the other shocks ε_t^o with their corresponding coefficients yields:

(8) $\Delta_{12} e_t \simeq \gamma_{12}^m(L) \varepsilon_t^m + \gamma_{12}^o(L) \varepsilon_t^o.$

This decomposition of the annual exchange rate changes into the contribution of last year's monetary policy and other shocks is depicted in Figure 3. It shows that the approximation (8) is accurate which implies that the effect of shocks older than one year is mostly negligible.

Figure 3: Approximate decomposition of the annual exchange rate change

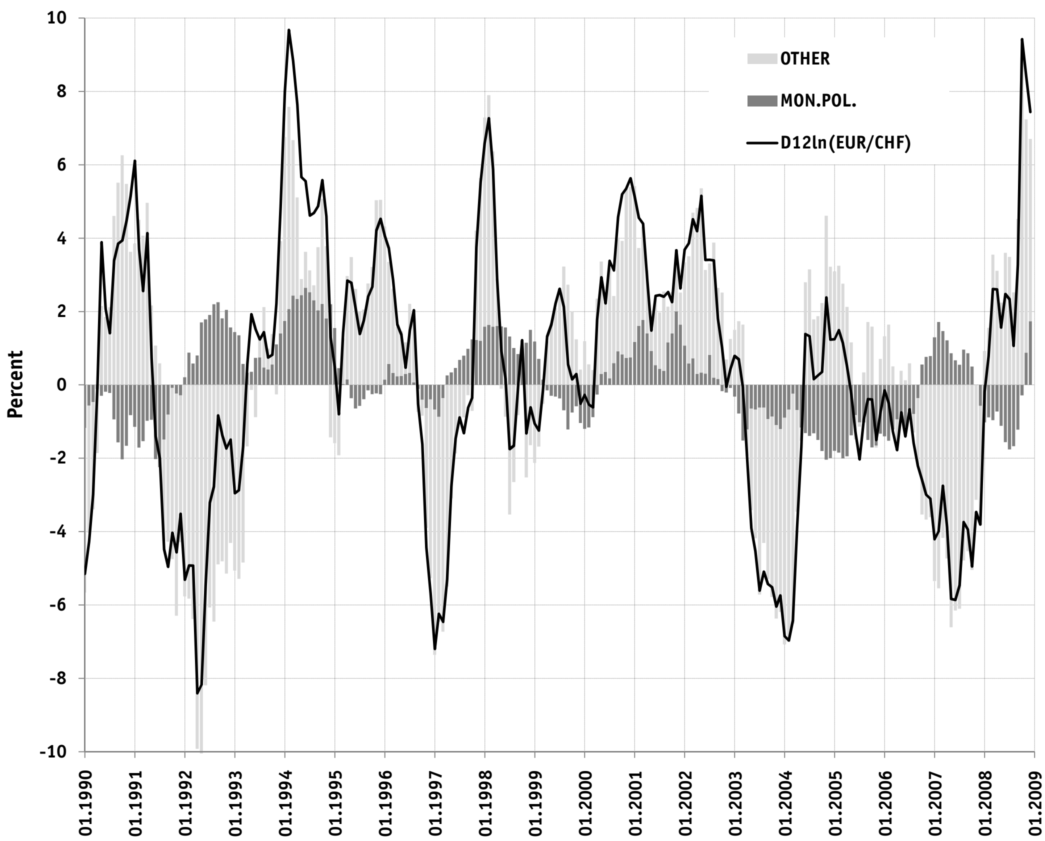


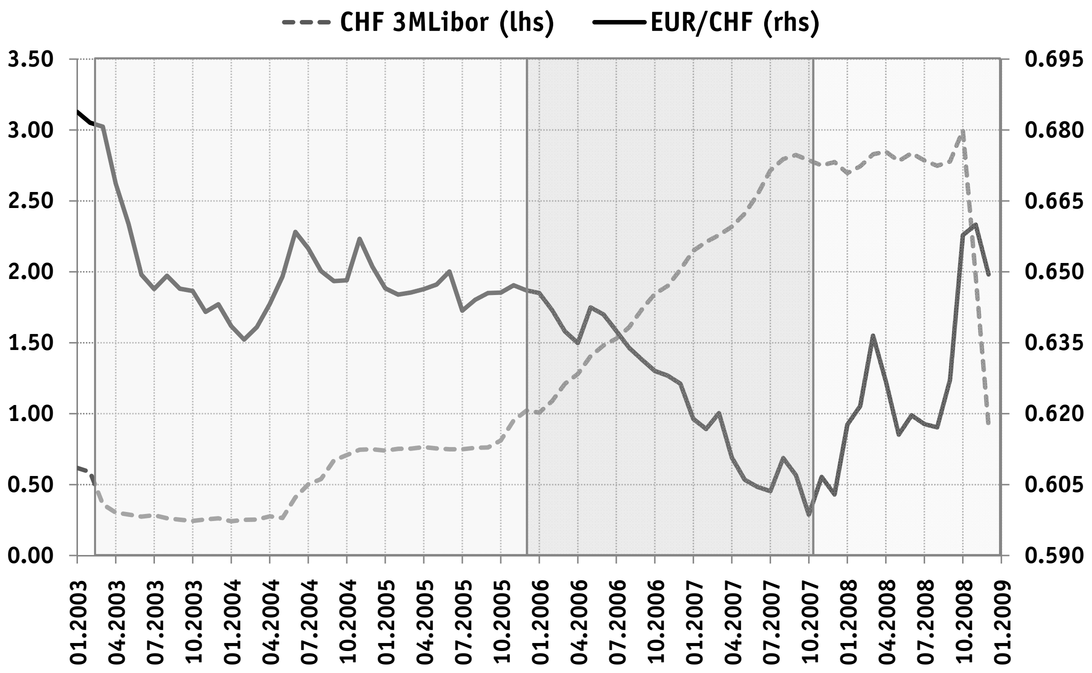
Figure 3 confirms the results of the variance decomposition with respect to the relative contribution of monetary policy shocks. However, even though the overall the annual exchange rate change is mainly driven by other shocks, there are some periods where the monetary policy shocks contributed substantially to exchange rate movements. A first episode is the Swiss franc appreciation in 1994, which would have been much less persistent without the tight monetary stance. A few years later, in 1998 and 1999, monetary policy had again a relatively strong influence on the exchange rate. In this episode the monetary policy shocks worked mostly in the opposite direction of the other shocks which lead to a rather low volatility of the Swiss franc against the euro. A last interesting example is the episode from 2003 to mid 2006, where the monetary stance was rather loose according to our decomposition. Whereas in 2003 the main driver of the Swiss franc depreciation were the other shocks, in 2004 the expansionary monetary policy prevented a stronger appreciation of the Swiss franc. Finally from 2005 to mid 2006 the easy monetary stance contributed substantially to the weakening of the franc.

6. An event study of Swiss franc movements between 2003 and 2008

In this section, we answer the question raised at the beginning of the paper: How does Swiss monetary policy contribute to movements in the Swiss franc vis-á-vis the euro? The variance decomposition and the historical decompositions of the annual exchange rate changes in the preceding section gave a general answer to this question for the complete sample and we have seen that the long-run contribution of monetary policy shocks to exchange rate variability is below 10 %. However, this does not preclude that in certain episodes with important monetary policy shocks, they make a larger contribution to exchange rate movements.

We analyse the period 2003-2008 and split this period into three episodes which are related to the level of the Swiss franc 3M-Libor. Figure 4 shows the corresponding movements of the 3M-Libor and the euro/Swiss franc exchange. The first episode runs from March 2003 to December 2005. In March 2003 the midpoint for the 3M-Libor target was set at 0.25% and it remained below 1% until December 2005 with only two 25 basis points hikes in between. This low level of the 3M-Libor was clearly associated with an expansive monetary stance and apparently contributed to a depreciation of the Swiss franc according to the monetary approach to exchange rates. A second episode starts in December 2005, with the first of eight consecutive 25-basis-point hikes in the 3M-Libor. During this episode, monetary conditions were getting tighter but the depreciation of the Swiss franc continues. This episode ends in October 2007, when the Swiss franc attained its historical low against the euro. The last episode runs from November 2007 to the end of 2008 and covers the market turmoil related to the subprime crisis and the subsequent financial crisis. During this period the Swiss franc appreciated by about 8%. The SNB kept the 3M-Libor target at 2.75% until October 2008, in the last quarter of 2008 the target was cut in four steps to 0.5%.

Figure 4: The euro/Swiss franc exchange and the Swiss franc 3M-Libor 2003–2008



Even though the movements of the 3M-Libor in Figure 4 already give some rough information about the stance of monetary policy the picture is not complete unless we refine the analysis. In particular, the movements of the 3M-Libor need to be disentangled into endogenous policy reactions and policy shocks. Doing so allows us to answer the two main questions we are interested in: How did Swiss monetary policy affect the Swiss franc during its depreciation against the euro between 2003 and 2007? Has there been an influence of Swiss monetary policy on the exchange rate during the recent appreciation of the Swiss franc?

To answer these questions we use again the structural VMA representation of the exchange rate. Given its value at some point in time τ, the future development is driven by the dynamic effects of the shocks occurring after τ and the persistence of all shocks which hit the exchange rate up to τ. This follows directly from repeatedly substituting in (5):

$$\begin{aligned}
e_{\tau+1} &= e_\tau + c_0\varepsilon_{\tau+1} + c_1\varepsilon_\tau + c_2\varepsilon_{\tau-1} + \ldots \\
e_{\tau+2} &= e_\tau + c_0\varepsilon_{\tau+2} + (c_0 + c_1)\varepsilon_{\tau+1} + (c_1 + c_2)\varepsilon_\tau + \ldots \\
&\vdots \\
e_{\tau+s} &= e_\tau + c_0\varepsilon_{\tau+s} + \ldots + (c_0 + \ldots + c_{s-1})\varepsilon_{\tau+1} + (c_1 + \ldots + c_s)\varepsilon_\tau + \ldots
\end{aligned}$$

This can be written more compactly as:

(9) $e_{\tau+s} = e_\tau + \gamma_s(L)\varepsilon_{\tau+s} + \tilde{c}_s(L)\varepsilon_\tau,$

where $\tilde{c}_s(L)$ contains the effects of the shocks up to τ. Note that $\gamma_s(L)$ is of order $s-1$ whereas $\tilde{c}_s(L)$ is of infinite order. Again, we decompose the vector of structural shocks between $\tau+1$ and $\tau+s$ into the monetary policy shock ε_t^m and the other shocks ε_t^o with their corresponding coefficients:

$$(10)\quad e_{\tau+s} = e_\tau + \gamma_s^m(L)\varepsilon_{\tau+s}^m + \gamma_s^o(L)\varepsilon_{\tau+s}^o + \tilde{c}_s(L)\varepsilon_\tau.$$

This decomposition can readily be calculated given the structural VMA representation and allows to break apart the movement of the exchange during a particular episode starting in $\tau+1$ and ending in $\tau+s$ into three components: The contribution of ongoing monetary policy shocks, other ongoing shocks, and past shocks. Ongoing shocks are those that occur within the period of interest (between $\tau+1$ and $\tau+s$), while past shocks are those that arose prior to this period.[4] We do not disentangle the contribution of past shocks into monetary and other shocks in order to keep the analysis focused.[5]

Figure 5: Factors contributing to Swiss franc depreciation, 2003 – 2005

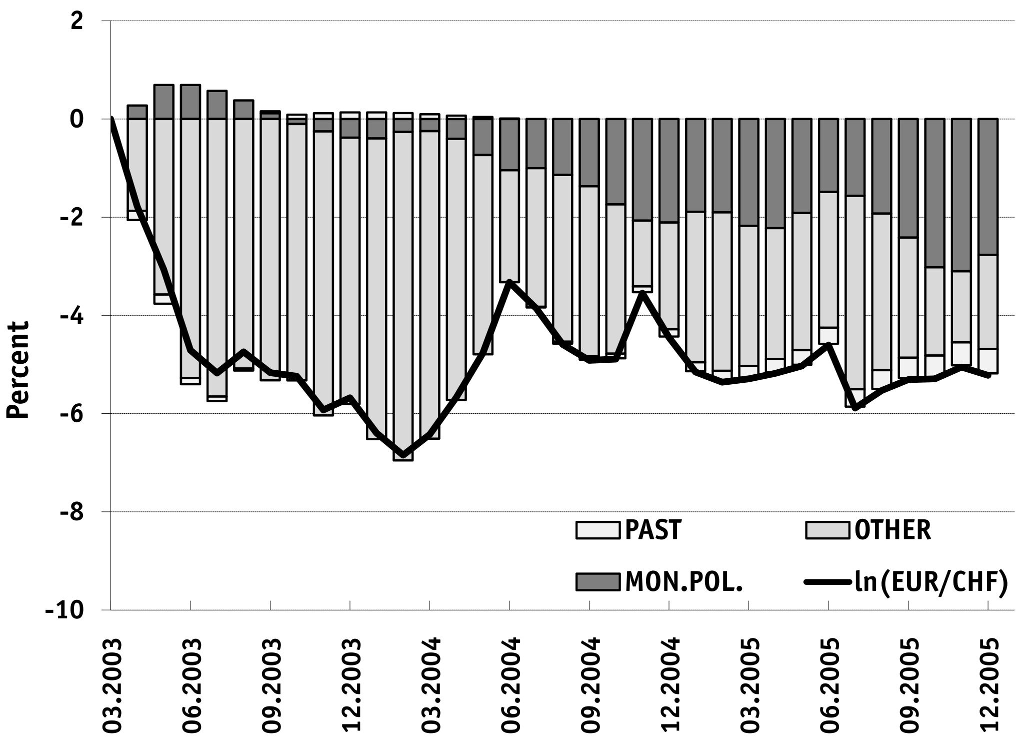


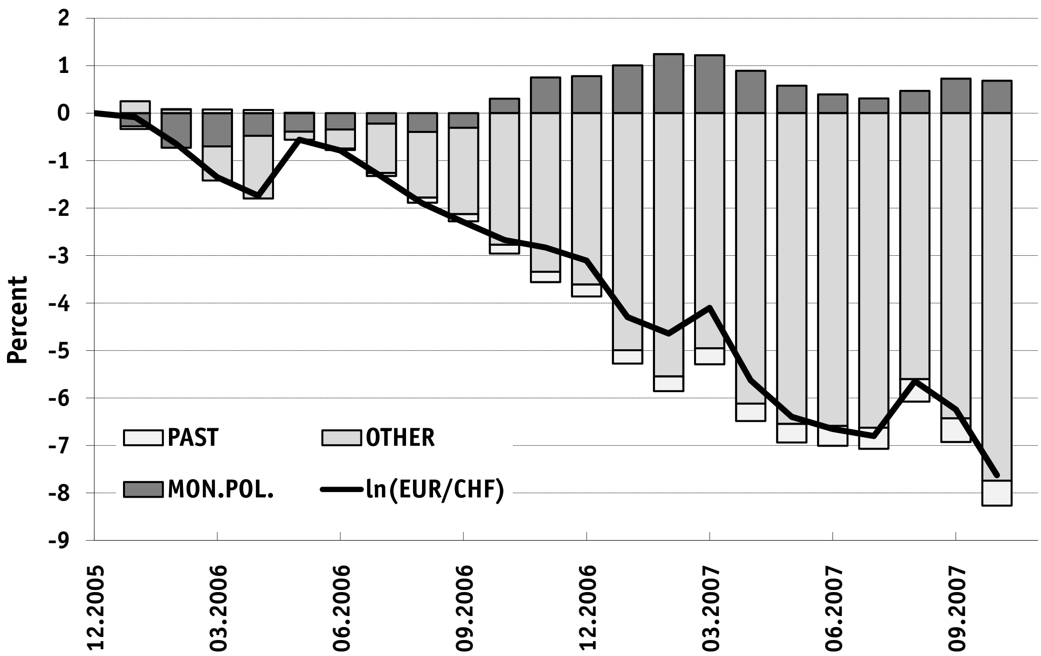
Figure 5 presents the movements in the exchange rate, measured in terms of euros against Swiss francs and expressed as a percentage, starting in March 2003. The bold line shows that the Swiss franc had depreciated by about 5% by December 2006. The bars represent the cumulative contributions of ongoing monetary policy shocks,

[4]Note that the effects of the ongoing shocks consists of the shocks occurring at the current date plus the accumulated effects of the shocks between the starting date and the current date.

[5]The empirical results show that the effects from the past shocks are small compared to the ongoing shocks. Of course, this reflects that forecasting the exchange rate is difficult.

other ongoing shocks and past shocks. We observe that the loose monetary stance is making an increasing contribution to the depreciation of the Swiss franc especially towards the end of this episode. Whereas, until mid 2004, other shocks contribute more to the depreciation, monetary shocks become the predominant cause for the downward movement in early 2005. By the end of 2005 their cumulative contribution to the weakness of the Swiss franc is clearly larger than that of the other shocks. Putting it differently, this means that about half of the Swiss franc depreciation against the euro in this episode was due to the relatively loose monetary policy stance from 2003 to 2005.

Figure 6: Factors contributing to Swiss franc depreciation, 2006 – 2007



The analysis of the subsequent episode leads to a different conclusion. Figure 6 shows that from December 2005 to October 2007, the Swiss franc depreciates by about 8% against the euro. Even though there is only a slight downward movement in the first few months, the monetary policy shocks play some role until June 2006. Their relative importance then decreases, and from October 2006 their contribution even favours an appreciation, if only weakly. The largest contribution to the strong depreciation of the Swiss franc in the final two years of this episode clearly comes from the other shocks. Taking into account that during this episode the SNB continuously increased the 3M-Libor by 25 basis points on a quarterly basis, this might be surprising. However, our analysis indicates, that this interest rate hikes were largely expected and in line with the usual response to macroeconomic conditions, hence they hardly affected the exchange rate.

Overall, we see that, according to the SVAR analysis, both monetary and other shocks contributed to the depreciation of the Swiss franc between 2003 and 2007. However, the main contribution to this depreciation clearly came from the other shocks, the influence of monetary policy shocks was limited to a short period. This immediately raises the question as to the nature of the other shocks. Our suggestion from the structural identification in Section 2 points to aggregate supply and demand, foreign monetary policy and exchange rate shocks as possible candidates. The variance decomposition attributes the largest importance to exchange rate shocks. We interpret these shocks as being mostly foreign exchange market disturbances representing real exchange rate changes, carry trades, safe haven effects, and the like. The clear tendency of the Swiss franc to depreciate together with its relatively low volatility and an interest rate differential in favor of the euro points to the carry trade as the main source of exchange rate shocks in 2006 and 2007, but this point deserves clearly more attention.

The second question we tackle in this section concerns the movements in the Swiss franc-euro exchange rate towards the end 2007 and in 2008. In particular, we would like to know whether monetary policy played an role for the recent appreciation of the Swiss franc. In addition we provide some information about the likely development of the Swiss franc in absence of the interest rate cuts in the last quarter of 2008.

Figure 7: Factors contributing to Swiss franc appreciation, 2007 – 2008

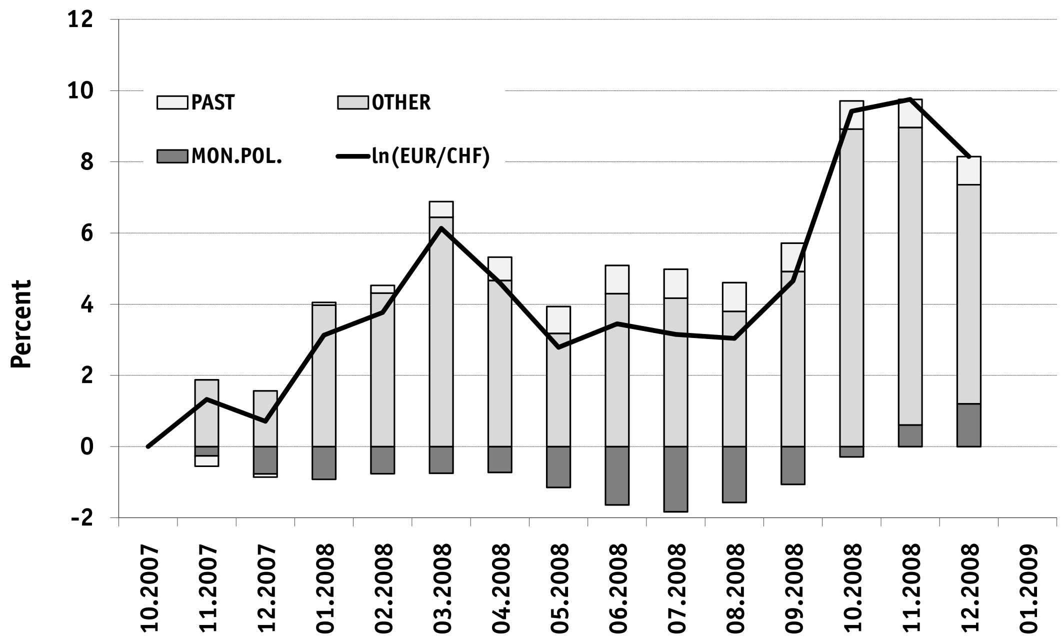
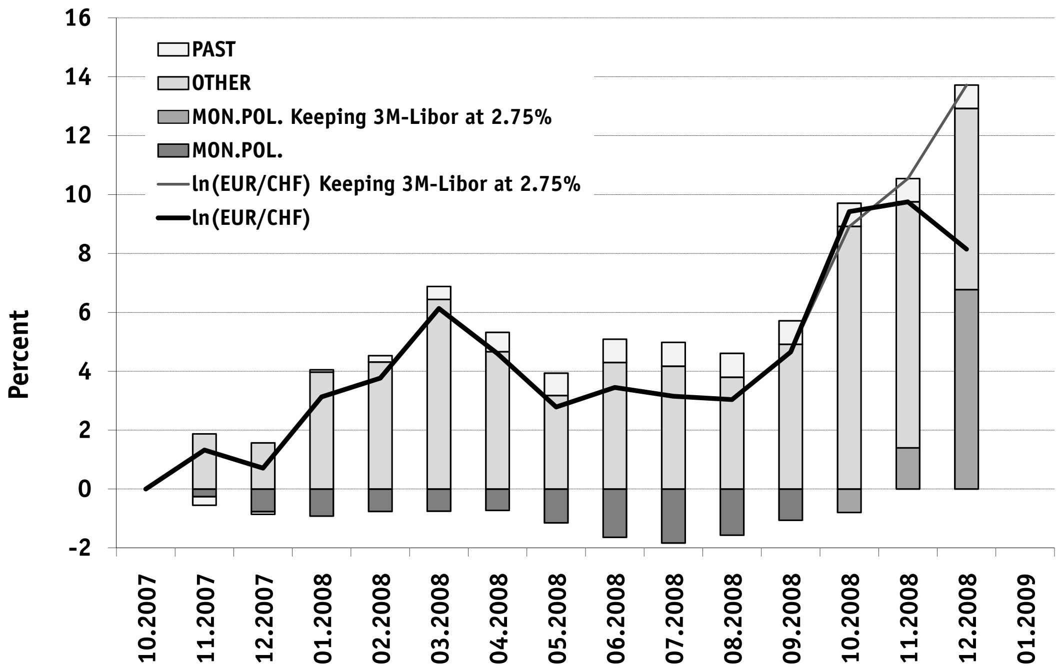


Figure 7 presents the corresponding results and shows that the 5% appreciation of the Swiss franc from October 2007 to October 2008 cannot be attributed to monetary policy shocks because the policy stance has been slightly expansive, especially in mid 2008. Again, the movement of the exchange rate is mainly driven by other shocks, in the present case we favour an explanation in terms of save haven shocks due to the subprime crisis.[6] This safe haven effects become stronger after September 2008, when the subprime crisis developed into a financial crisis after the Lehman Brothers collapse. Note that in November and December 2008 our analysis indicates a slight tightening of the monetary stance even though the 3M-Libor target was cut by a total of 200 basis points. This is possibly surprising as it means that monetary conditions were tighter than expected given the prevalent situation, especially the strong appreciation of the Swiss franc in September and October. An explanation for this result is that the measurement of monetary policy shocks has been impaired because the actual 3M-Libor was mostly above the target due to higher risk premia.

In order to shed some more light on the effects of the policy actions in the last quarter we conduct a simple counterfactual experiment and ask the question: What would have happened to the exchange rate if the SNB had decided to keep the 3M-Libor unchanged at a value of 2.75% for the last quarter of 2008? This amounts to feed three monetary policy shocks into the VAR system in order to keep the interest rate constant given the measured values for the other structural shocks. Of course, such an experiment constitutes a clear deviation from the usual conduct of monetary policy and is therefore subject to the Lucas' critique. Keeping this in mind it is still instructive to have a look at the results of this exercise in Figure 8.

Figure 8: Keeping the 3M-Libor constant at 2.75% in the last quarter of 2008



Whereas the first shock in September is slightly expansionary because the actual 3M-Libor is slightly above the target value, the shocks in November and December

[6]Ranaldo and Söderlind (2007) show with high-frequency data that the Swiss franc has safe haven properties against the euro and other currencies in times of financial turbulence.

have a strong contractive effect. The exchange rate appreciates strongly and exceeds the actual value by 6% in December. The monetary policy shocks end up explaining about half of the overall appreciation between October 2007 and December 2008.

7. Conclusions

In this paper we analyse the contribution of Swiss monetary policy to movements in the Swiss franc against the euro. In particular, we measure the relative contribution of monetary policy versus other factors to the depreciation of the Swiss franc between 2003 and 2007 and to the appreciation in 2008. The empirical results of this exercise lead us to the following conclusions: First, the average contribution of monetary policy shocks to fluctuations in the exchange rate is between 7% and 15% for the period 1981 to 2007. Second, our results indicate that the monetary stance was relatively loose from 2003 to 2005. This monetary expansion was responsible for about 3% of the 5% depreciation of the Swiss franc against the euro between 2003 and 2005. Third, since 2006 the effects of monetary policy on the exchange rate have diminished substantially, most of the variation in the Swiss franc-euro exchange rate is explained by non-monetary factors.

Three caveats need to be mentioned with respect to these results. One is related to the econometric methodology applied to measure monetary policy shocks. It relies on the assumption that there has not been a fundamental change in the monetary policy regime over the estimation period. In our opinion this assumption is correct for the considered time interval, in particular with respect to the primary objective of Swiss monetary policy. Even though the operating procedure has substantially changed, Swiss monetary policy has been directed towards maintaining low and stable inflation rates since the transition to flexible exchange rates. The second caveat concerns the interpretation of the exchange rate movements, which are not related to Swiss monetary policy. We interpret these shocks tentatively as representing real exchange rate changes, carry trades, safe haven effects, foreign monetary policy and the like. However, we do not attempt to provide a more detailed breakdown. Finally, the focus of the study is on the analysis of historical episodes and not on the medium or long-run forecast of the exchange rate. In particular, it does not concentrate on the long-run appreciation trend of the Swiss franc against the euro, which is due to the inflation differential and movements in the real-exchange, but on the deviations from this trend.

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