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Fluctuations in the Swiss Franc:
What has Changed Since the Euro's Introduction?

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Abstract

The monetary implications arising from EMU for Swiss monetary policy show up primarily in the exchange rate. Until now, fluctuations in the Swiss franc against the euro have been surprisingly moderate. The Swiss franc has thus tracked the euro's decline against the US dollar without experiencing strong inflationary pressures and a convergence in the interest-rate differential: a paradoxical result for a small open economy. This paper examines critically whether the recent record reveals information about a change in SNB monetary policy. It also attempts to shed light on the SNB's ability to implement an independent monetary policy with the new landscape defined by EMU. Four hypotheses of euro tracking are considered.

The introduction of the euro was portrayed as one of the biggest challenges for Swiss monetary policy in recent years. As an indirect measure of its seriousness, more than 60% of the speeches by Swiss National Bank (SNB) Board members from 1997 to 2001 were addressed to issues concerning the euro. The prevailing view is that the monetary implications arising from the common currency will show up primarily in the Swiss franc. Before its outset, many Swiss policymakers expressed concern that the Swiss franc would appreciate against the euro and increased exchange rate volatility would ensue.

To understand the position of Swiss policymakers, it must be remembered that the general mood in Switzerland before the introduction of the euro was one of mistrust towards the European Monetary Union (EMU). This skepticism was not only lodged against the EMU project, but also against the European Union (EU) as a viable institution. Switzerland has yet to hold a referendum on EU membership. The pessimistic sentiment is well captured in the Kommission für Konjunkturfragen (1996). In this commissioned report to the Federal government, several policy scenarios assuming EMU credibility problems were considered. The report outlined the policy tradeoffs the SNB would face of an appreciating Swiss franc. Potential safe haven effects, which would put appreciating pressures on the Swiss franc, were repeatedly mentioned in the report.

The report was drawn up in a climate where the Swiss franc appreciated strongly against the major European currencies from 1994 and 1996. These exchange rate developments came at an inopportune time when Switzerland was trying to dig itself out from a prolonged recession. The exchange rate fears were afterwards compounded by international events beginning with the Asian crisis and then with the Russian crisis. The crises instilled a flight to quality placing renewed upward pressure on the Swiss franc.

A further concern of Swiss policymakers was that the European Central Bank's (ECB) exchange rate policy would differ from the Bundesbank's policy. The open economy focus of the Bundesbank suited the SNB well, because the German mark/US dollar exchange rate, hereafter DEM/USD exchange rate, played an important role in the Bundesbank's policy setting. The Bundesbank frequently allowed its currency to appreciate against the US dollar to offset domestic price pressures. This policy strategy was often compatible with that of the SNB. The

outcome was a Swiss franc/German mark exchange rate, hereafter CHF/DEM exchange rate, characterized by moderate fluctuations over the last two decades. However, with the new constellation of the euro area, a large share of EU-12 trade is intra-regional trade. The common view is that the ECB will be less concerned with open economy issues than was previously the case when the Bundesbank dominated European monetary policy. The fear is that the ECB can afford large currency fluctuations without jeopardizing its price and output objectives, while the SNB cannot.

Another consideration is the future of Swiss interest rates under EMU. For reasons not fully understood, Swiss rates are on average 150 basis points lower than their euro equivalent. This phenomenon dates back several decades if German long-term rates are used as a benchmark. The low interest rate environment enabled Swiss households and firms to take on high levels of debt. A fear of many Swiss policymakers is that a rapid convergence of Swiss rates to euro levels could have serious repercussions for the domestic credit market and economic activity. If the SNB felt compelled to maintain this interest rate advantage, it would have to allow the Swiss franc to appreciate.

Since the introduction of the euro, short-term fluctuations in the Swiss franc/euro exchange rate, hereafter CHF/EUR exchange rate, have been extremely moderate when compared to their historical trends. Exchange rate stability came about in the absence of the feared capital inflows and the interest rate differential of Swiss rates to euro rates has not narrowed. This outcome has surprised many given the sentiment prior to the euro's introduction. The exchange rate result is ever more perplexing in that the SNB has recently re-emphasized its commitment to price stability with the announcement of its new monetary concept in December 1999. Under the SNB's new monetary concept as under the previous monetary frameworks of monetary targeting, the Swiss franc floats freely.

From an analytical perspective, the Swiss franc's stability against the euro is of interest in light of the attention received in predicting its future course prior to 1999. While many Swiss policymakers correctly predicted the euro's weakness for various reasons, what is rather astonishing is that the Swiss franc has tracked much of the euro's decline against the US dollar. This paper puts forth and appraises many of the hypotheses that have been advanced for the Swiss franc's stability. The

analysis also tries to identify to what extent is today's position sustainable for the foreseeable future.

The paper is organized as follows. Section 1 reviews the recent developments in the CHF/EUR exchange rate. The picture that emerges is one of relative calm. This is not only true from a historical perspective, but also in terms of the recent exchange rate performance of other euro-outsiders that float their currency: the United Kingdom, Sweden and Norway. Section 2 puts forth several hypotheses that seek to explain the smooth behavior of the Swiss franc. In the absence of asymmetric shocks, the hypotheses are testable in that they make predictions regarding the behavior of key macro variables. Section 3 presents rudimentary evidence that attempts to sort the competing hypotheses. Section 4 concludes with several remarks regarding the sustainability of the current situation.

1. A Review of Swiss Franc Fluctuations

Since the breakup of Bretton Woods, the SNB has pursued several policy strategies based on monetary targeting and more recently its has gone over to a policy framework that relies on inflation forecasts as its main indicator. Under each of these frameworks, the Swiss franc has floated freely except for a brief period in 1978-1979. During the 1978-1979 period of so called exchange rate management, the SNB interrupted its practice of announcing an annual monetary target and set a floor for the DEM/CHF exchange rate for the year 1979. Rich (1997 and 1990) offers a review of Swiss monetary targeting and problems linked to the Swiss franc.

More recently, the SNB has acknowledged on certain occasions that it has reacted to extreme exchange rate movements in the Swiss franc. This implied that the SNB injected or took out liquidity in the money market. The most recent example took place on 24 September 2001 when the SNB lowered its target range for the three-month Libor by 50 basis points on the grounds that the Swiss franc had rapidly appreciated against the euro.

To motivate the discussion of Swiss franc fluctuations and the possible impact stemming from the euro's introduction, Figure 1 plots the daily percentage difference between the high and low exchange rate prices. The first half of the sample from 3/1/1996 to 31/12/1998 uses the CHF/DEM exchange rate, whereas the second sample from 1/1/1999 to 31/1/2002 uses the CHF/EUR exchange rate. Nelson (1992) has argued that this measure of volatility is quite accurate for short samples.

An ocular view of Swiss franc fluctuations in Figure 1 finds that the level of exchange rate volatility dropped considerably after the euro's introduction. The volatility of the CHF/EUR exchange rate remained low till March 2000 and increased slightly thereafter. To understand better whether this drop in exchange rate volatility stemmed from Swiss franc pegging, this section provides a closer look at the data.[1] The analysis of Swiss franc fluctuations uses monthly data from 1973 to 2001.

Historical Trends

To gain an understanding of the long-run trend of the Swiss franc, Figure 2 plots the DEM/CHF exchange rate from 1973 to 2001. Before the introduction of the euro, the German mark was regarded to be the most important cross rate for Swiss economic activity. Three observations stand out in Figure 2. The first is that the nominal and the real exchange rate did not deviate sharply from each other. The deviations in the two exchange rates are persistent, but the gap does not exceed +/- 2.5%. This reflects the parallel inflation performance of the two countries.

The second observation concerns the relatively stable DEM/CHF exchange rate during the 1980-1999 period compared to the earlier 1973:1-1979:12 period. Genberg and Kadareja (2001) refer to the former period as an explicit target zone, where the SNB tried to maintain the exchange rate within an 80 to 90 DEM/CHF range. They also note that the same episode was characterized by exchange rate smoothing on the part of the SNB, because it was much more interested in output stability than was previously the case in the 1970s.

The third observation, which is related to the previous remark, concerns the difficulty in determining an appreciation trend or trends that is representative of the floating period. The issue is important for understanding, which trends are expected to prevail for the CHF/EUR exchange rate. It is well known that segmented trends are sensitive to the selected sample. For example in Figure 2, the exchange rate trend between 1973:1 and 1998:12 corresponds to a 1.7% annual appreciation of the Swiss franc. The appreciation trend increases to 3.8% per year for the shorter sample from

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[1] An alternative explanation for the reduced volatility is the change in the microstructure (i.e., issues of information or spreads) that is linked to the euro's introduction. See Hau, Killeen and Moore (2000) and Portes and Rey (1998) for opposing views about the changing microstructure linked to the euros introduction. I do not pursue this avenue, however, the evidence on the *cross rates of other outsiders*

1973:1 to 1979:12, is 0.7% for the period from 1980:1 to 1998:12, and is 0.0% for the most recent episode from 1996:1 to 1998:12. The information from the most recent period suggests that the appreciation fears in Switzerland before the euro's introduction were not necessarily consistent with historical trends.

Simple Volatility Measures

Figure 3 plots a snap shot of the CHF/EUR exchange rate; three years prior and three years after the introduction of the euro (the ECU is used before 1999). A striking feature of the graph is that the fluctuations in the CHF/EUR exchange rate dampened in the period from September 1998 to March 2000. The SNB in its Annual Report 1999 acknowledged on page 40 that stabilizing the exchange rate was an intentional policy for the first months into 1999. Yet from Figures 1 and 3, it is clear that the volatility in the CHF/EUR exchange rate has not returned to the levels observed prior to 1999.

To document the dampening behavior of Swiss franc fluctuations further, Table 1 presents normalized standard deviations for the effective, the CHF/USD and the CHF/DEM exchange rates. Standard deviations for various subperiods are presented along with the ratio for the US dollar and German mark against the effective exchange rate. The volatility measures underscore two features. The first is a dampening of exchange rate volatility over time. This is true for all three exchange rates. The second observation is that the ratio of the standard deviations between the DEM/effective exchange rate is fairly stable at 0.8 across time. This result, which appears to be true for the post-euro period, says that the effective exchange rate on average took on 25% more volatility than did the volatility of the CHF/DEM exchange rate.

Cross Rates of other Outsiders

A comparison of the exchange rate of Europe's outsiders with respect to the euro offers an alternative picture as to how tightly the Swiss franc has tracked the euro. Apart from Switzerland, the outsiders are Denmark, Norway, Sweden, and the United Kingdom. Fischer (2001) provides a survey of Europe's outsiders and argues that the EMU *outs* (i.e., Denmark, Sweden, and the United Kingdom) face the same

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suggests that it is not just microstruture issues that are driving the short-run volatility in the Swiss franc.

monetary challenges as the EMU and EU *out-outs* (i.e., Norway and Switzerland). Differences in policy lie in the country's economic structure and not in their institutional affiliation.

Figure 4 plots the British pound, Norwegian krone, the Swedish krona, the Swiss franc and the euro against the US dollar since 1999. The exchange rates have been normalized to facilitate comparison. The Danish krone is not considered, because it pegs tightly the euro. The currency profiles show that the euro has been the weakest among the so-called European floaters for much of the sample except for the Swedish krona after January 2001. At its trough in November 2000, the euro lost 35% of its value against the US dollar. Many studies have attempted to explain the euro's demise, however a clear consensus has yet to emerge.[2]

Two important observations stand out in Figure 4. The first is that the outsiders did not behave uniformly against the euro. The British pound and the Norwegian krone were fairly stable against the US dollar, bouncing within a +/-2.0% range in 1999. Thereafter the Norwegian krona depreciated in line with the Swedish krona briefly. The British pound instead continued its US dollar path till the first quarter 2000 and then depreciated slowly against the US dollar. The opposite extreme is the fluctuation of the Swiss franc and the Swedish krona. They tracked the euro from its beginning. The Swedish krona moved tightly in line with the euro for the first six months in 1999 and then took on greater volatility against the euro. The Swiss franc tracked the euro the longest till April 2000.

The second observation that can be taken from Figure 4 is that only the Swiss franc exhibits the same short-term fluctuations as the euro. This evidence is re-enforced by the correlation matrix offered in Table 2. The correlations are the monthly change in the US dollar exchange rates. The short-term fluctuations of the Swiss franc and the euro have a correlation of 0.96. No other outsider yields such a high correlation with the euro. Apart from the Swedish krona and the Norwegian krone, the correlation among the outsiders is not higher than 0.50. This suggests that the Norwegian, British and the Swedish monetary authorities have attempted to balance the fluctuations between the US dollar and the euro, whereas the SNB has sought to smooth the volatility with the euro.

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[2] Meredith (2001) and Tille, Stoffels and Gorbachev (2001) provide a survey of the key economic arguments that attempt to explain the euro's decline.

The euro tracking result of the Swiss franc is surprising in the light of the fact that many outsiders have only recently committed themselves to floating their exchange rates. The Norges Bank has only shifted its policy framework based on inflation targeting since March 2001. Before the change in policy, the Norges Bank's objective was to stabilize the currency against the euro. But even in the first two years of the euro, the Norwegian krone fluctuated more strongly against the euro than did the Swiss franc. Similarly, the Swiss franc has a longer track record of floating than the Swedish krona and the British pound. It is only as of 1993 that the latter currencies are floating freely. A further issue in the case of the Riksbank is that they operate under the internal target that the changeover required for EMU membership can be managed within one year of a political decision (Annual report 2000, Sveriges Riksbank, page 24).

2. Explanations of Euro Tracking

This section presents four hypotheses that offer an explanation of the low short-term volatility observed in the CHF/EUR rate over the last three years. The hypotheses assume that no asymmetric shocks have occurred and that the productivity trends in Switzerland and the euro area are roughly similar. Long-run arguments used to explain the euro's demise against the US dollar are not considered here.

European Convergence

The convergence hypothesis says the common currency area has raised Switzerland's economic interdependence with Europe. The hypothesis states that the relationship between various optimum-currency area (OCA) characteristics (income, trade and size) and the observed behavior of the exchange rate have become stronger for Switzerland since the euro's introduction. With Switzerland's unique OCA characteristics, the thrust of the convergence hypothesis is that the SNB should pursue a pegging strategy, because the benefits of a domestically oriented monetary policy have diminished.

One issue where this argument applies in particular is Switzerland's trade with the rest of Europe. Germany is traditionally Switzerland's most important trading partner where 29% of Swiss exports go to and 35% of Switzerland's imports come from its northern neighbor. With the common currency, roughly 50% of

Switzerland's exports go to and 70% of Switzerland's imports come from the euro area. Table 4 offers a better view of how Switzerland's trade links match up with other European outsiders. Swiss and British exports to the euro area make up more than half of their export destination. For these two countries, exports to the outsiders are limited. What stands out in this maze is that more than a quarter of Swedish and Norwegian exports go to other Nordic outsiders.

A look to OCA estimates provides further support of a pegging strategy for Switzerland. The OCA estimates by Bayoumi and Eichengreen (1997) reproduced in Table 5 is constructed using income, trade and size differentials with respect to Germany. Low index values imply a higher degree of OCA. The Bayoumi-Eichengreen estimates find strong evidence that Switzerland is converging towards a European OCA. The index values for Switzerland fall over time and they are well within the European average. The index values of the other outsiders do not have the same profile.

SNB and ECB: "Two of a Kind"

The two-of-a-kind hypothesis says that the monetary strategies of the ECB and SNB are similar. Both central banks are granted a high level of goal independence, operate with the same definition of price stability (an inflation rate below 2 percent), and rely on broad money as a main indicator for monitoring long-run inflationary pressures. This hypothesis assumes that the SNB pursues an autonomous monetary policy. With the SNB's policy compatibility to the ECB, it is therefore not surprising that interest rate settings by the two monetary institutions have not deviated sharply from each other. As a consequence, a relatively stable CHF/EUR exchange rate ensues.

The compatibility argument was often made for the Bundesbank and the SNB. Rich (2000) argues that the Swiss franc's long-run stability against the German mark was due to similar monetary strategies. As a token of proof, the exchange rate record of many European countries that officially pegged their currency against the German mark exhibited greater exchange rate variability than did the Swiss franc over the 1980-1999 period.

"Fear of Floating"

Calvo and Reinhart (2000), Ghosh, Gulde, Ostry and Wolf (1997), and Reinhart (2000) analyze the behavior of exchange rates, foreign exchange reserves, monetary aggregates, and interest rates across different exchange rate arrangements to assess whether the official labels provide an adequate representation of actual country practice. Their key finding is that relative to more committed floaters, such as the United States, Australia, and Japan, observed exchange rate variability is generally quite low. Because the volatility of interest rates and reserves is found to be high for the fear of floating country, the observed stability in the exchange rate is interpreted as being a deliberate result of policy actions. This suggests that countries are not relying exclusively on foreign exchange rate interventions to smooth fluctuations in the exchange rates. The high variability of interest rates also suggests that there are chronic credibility problems.

The fear-of-floating hypothesis has been used to explain the lack of exchange rate volatility in the currencies of developing and emerging-market countries that claim to be exchange rate floaters. A pegging strategy is pursued on the grounds that central banks of these respective countries lack a proven track record. Credibility problems do not allow the central bank to carry out an autonomous monetary policy.

The same argument can be turned on its head and applied to the Swiss case. Here, the fear-of-floating hypothesis says a pegging strategy is sought because of safe haven fears or the country's historical fears of an appreciating exchange rate. When circumstances are favorable (i.e., there are capital inflows, positive terms-of-trade shocks, etc.), the SNB is reluctant to allow the nominal exchange rate to appreciate because of fears relating to a loss of competitiveness and serious setbacks to export diversification. Alternatively, when circumstances are adverse, the case against allowing a large depreciation can become more compelling. The Swiss monetary authorities may resist a large devaluation because of possible inflationary consequences.

"Wait-and-See"

The wait-and-see hypothesis says that the observed stability in the Swiss franc stems from a series of special events. These include the introduction of the euro in 1999, the introduction of a new monetary strategy by the SNB, and precautionary measures undertaken in the preparation of Y2K. These events generated a perceived sense of uncertainty and the SNB responded cautiously to the new environment. The

outcome was a policy in which the Swiss franc was deliberately pegged to the euro during 1999-2000.

One implication of the wait-and-see hypothesis is that the volatility of the CHF/EUR exchange rate should increase after 2000. The rationale is that the special factors surrounding 1999-2000, which may also be attributed in part to the fear-of-floating argument, have been completed and new projects of similar magnitude are not foreseen. The wait-and-see hypothesis predicts that the exchange rate volatility should return eventually to its pre-euro levels.

A weakness of this hypothesis is that the special events of 1999-2000 do not pertain to Switzerland alone. Since other EMU-outsiders were confronted with similar policy conflicts as Switzerland, this suggests that, in the absence of any specific country shocks, the volatility profile should be similar for outsiders' currencies. The evidence from Figure 4 suggests that this was not the case. The monetary authorities of the United Kingdom, Sweden, and Norway allowed their currencies to take on greater volatility against the euro than was observed for the Swiss franc. A way to save the wait-and-see hypothesis from its grave is to claim that the SNB was particularly preoccupied with appreciation fears because of incoming capital flows from the euro area. To allay such fears of an appreciating Swiss franc, the Swiss monetary authorities pegged the Swiss franc to the euro for a brief period in 1999. SNB policy thereafter should become more independent and greater levels of exchange rate volatility should be observed.

3. A Rough Look at the Data

This section attempts to separate the hypotheses put forth in the previous section. The analysis is model free and relies on simple volatility measures. Two measures of volatility are considered: variances and probability measures.

Variance Analysis

One simple test of the hypotheses is to conduct a variance analysis for the possible restrictions of key macroeconomic variables. The convergence hypothesis says that the volatility of the CHF/EUR exchange rate and the interest rate differential should become smaller over time. The restriction for the convergence hypothesis thus simply defines the monthly variance from the second period to be lower than the first, i.e., $VAR(e_1) > VAR(e_2)$ and $VAR(i_1 - i_1^*) > VAR(i_2 - i_2^*)$, where * denotes

the foreign interest rate. Since the post-euro sample is relatively short, only two periods are considered: 1999:1-2000:6 and 2000:7-2001:12.

Next, the wait-and-see hypothesis considers the same variables as in the convergence hypothesis, but the inequality restrictions run in the opposite direction. In other words, wait-and-see behavior predicts that the reduction in short-run volatility was only temporary at the time of the euro's introduction and thereafter foresees an increase in volatility. In terms of the variance restrictions, this is defined as $VAR(e_1) < VAR(e_2)$ and $VAR(i_1 - i_1^*) < VAR(i_2 - i_2^*)$.

The fear-of-floating hypothesis in contrast says that the SNB smoothes intentionally the exchange rate due to appreciation fears. The variance of the monthly change in the Swiss three-month Libor, Δi, should thus be higher than that of the monthly change in the euro three-month Libor, Δi^*, if the fear of floating hypothesis is correct. In this case the variance restriction becomes $VAR(\Delta i) > VAR(\Delta i^*)$. The volatility of exchange rate reserves is another variable considered by Calvo and Reinhart (2000) in their test of the fear-of-floating hypothesis. This strategy is not pursued, because it is publicly known that the SNB has not intervened in the FOREX market since 1995.

Lastly, the variance restriction of the two-of-a-kind hypothesis is conditional on inflation forecasts. It says that the SNB and the ECB behave similarly. Both central banks place a high priority on price stability. If the variance of the ECB's (SNB's) inflation forecasts is higher than that of the SNB's (ECB's) forecast so will be the variance of the euro (Swiss) Libor. In other words, if $VAR(\pi) > (<) VAR(\pi^*)$ then $VAR(i) < (>) VAR(i^*)$. Because there are so few observations on inflation forecasts for the post 1999 period, I use the variance of the CPI inflation rate instead of the inflation forecast.

Table 5 summarizes the variance measures. The variance of monthly changes in the CHF/EUR exchange rate was slightly higher in the second half of the sample. The same is true for the interest rate differential. These two variance results are at odds with the convergence story and are consistent with the wait-and-see hypothesis.

The variances of the other variables do not allow one to exclude the remaining hypotheses. For each period, the variance of the Swiss interest rate changes is greater than the variance of the euro rates. This result is consistent with the fear-of-floating hypothesis. At the same time, the variance of the monthly CPI

changes is higher than the variance for euro area inflation. Thus, it is difficult to determine if the higher variance for Swiss interest rates was due to appreciation or inflation fears.

Probability Measures

An alternative measure of short-run volatility is a probability measure, which defines the frequency of occurrence for a defined threshold. Table 6 provides evidence on the likelihood that the monthly change in the euro cross rates is less than 1%. Results are given for three subperiods: 1993:1-1995:12, 1996:1-1998:12 and 1999:1-2001:12. The euro cross rates are against the four European outsiders and the US dollar. The later is used as a comparative measure of free floating. Before 1999, the German mark is used as a proxy for the euro.

The cross rate results with the US dollar show the highest degree of fluctuation across the three subperiods. The probability that the US dollar did not deviate more than 1% from the German mark or the euro lies between 0.17% and 28%. These are the lowest likelihoods. In contrast, the highest likelihood is 0.92% for the Norwegian krone during the first subperiod from 1993:1 to 1995:12. This smoothing result is consistent with the Norwegian policy of pegging the krone to the ecu within a narrow band. In later periods, the Norges Bank allowed its exchange rate fluctuation bands to widen and since 2001 it has followed a policy of inflation targeting. These policy changes allowed the krone to take on greater fluctuations against the German mark and the euro. The opposite development is seen in the Swiss franc. Consistent with the results from the first section, the exchange rate fluctuations diminished over the three sample periods such that the likelihood of the Swiss franc not deviating more than 1% for a certain month reached 0.83% for the euro period. The likelihood values for the other currencies are considerably lower.

Of greater interest is to examine the probabilities in interest rate changes. Table 7 documents the likelihoods for the three-month Libor not fluctuating more than 10 basis points for a certain month. The threshold level should be small enough so that it does not correspond to a change or anticipated change in the central bank's key policy rates. The probability values for the German and the euro rates lie between 0.33% and 0.50%. In the extreme, the higher probability of 0.50% for the euro rate could be interpreted as evidence that the ECB is more concerned with

interest rate smoothing than was the Bundesbank. Next, using the Norwegian rates as a reference for how interest rates behaved under a regime of exchange rate pegging, the likelihood was 0.11% for the 1993:1-1995:12 period. In other words, the Norges Bank achieved exchange rate stability through volatile interest rate changes. If one compares the probability levels for Swiss interest rates during the most recent period of euro stability, the degree of interest rate smoothing is similar to the other floaters. From this information, I conclude that the volatility of the Swiss interest rates is not large enough to be consistent with the fear-of-floating hypothesis.

4. Concluding Remarks

With the limited period of review and the poor record of economists in explaining ex-post exchange rate movements, it is important not to overstate any claims concerning Swiss monetary policy and the euro. However, an exceptional feature of the CHF/EUR exchange rate is its low volatility; an outcome that was not anticipated before the euro's introduction. The volatility result does not suggest that there is an increased cost for Switzerland staying out of the currency bloc.

Different volatility measures highlight three features of the short-run fluctuations in the CHF/EUR exchange rate. First, the volatility profile of the Swiss franc against the euro has changed dramatically during the post-1999 period compared to previous episodes when the German mark is used as a benchmark. Second, among the European floaters, the short-run movements in the Swiss franc exhibit the highest correlation with the euro. Third, volatility in the CHF/EUR rate is characterized by small fluctuations with infrequent one-time appreciation shifts in the Swiss franc.

The analysis considers four hypotheses that seek to explain the change in the short-run volatility of the CHF/EUR exchange rate. The ability to disentangle the hypotheses is made difficult for Europe's transition to a common currency did not pose any significant policy dilemmas for the European floaters. Identification is also made difficult in that there were no asymmetric shocks between Switzerland and the euro area. Still, simple volatility measures of key macroeconomic variables revealed weak evidence that the fear of floating and the convergence hypotheses are inconsistent with the actual data. More plausible explanations are the wait-and-see and the two-of-kind hypotheses. A combination of the latter hypotheses says that the SNB intentionally pegged the exchange rate and took on a cautious posture before

and after the introduction of the euro. Once the feared uncertainties linked with the euro's introduction subsided, the SNB pursued a policy oriented towards its own domestic concerns, where the maintenance of price stability became the overriding priority.

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Figure 1: Daily Percentge Difference between
High-Low Exchange Rate Prices
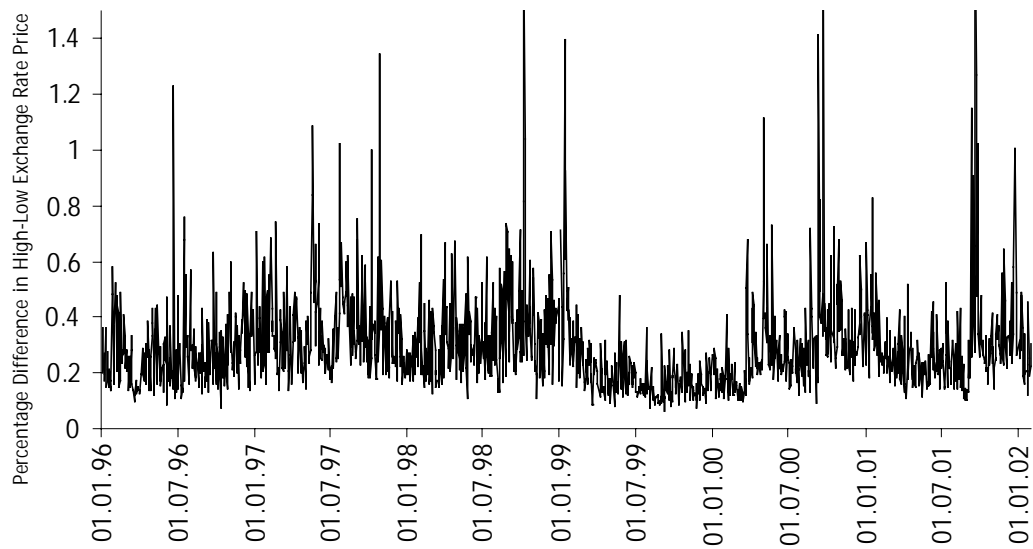
Note : The exchange rate is the CHF/DEM from 1996 to 1998 and the CHF/EUR from 1999 to 2002.

Figure 2: German Mark / Swiss Franc Exchange Rate
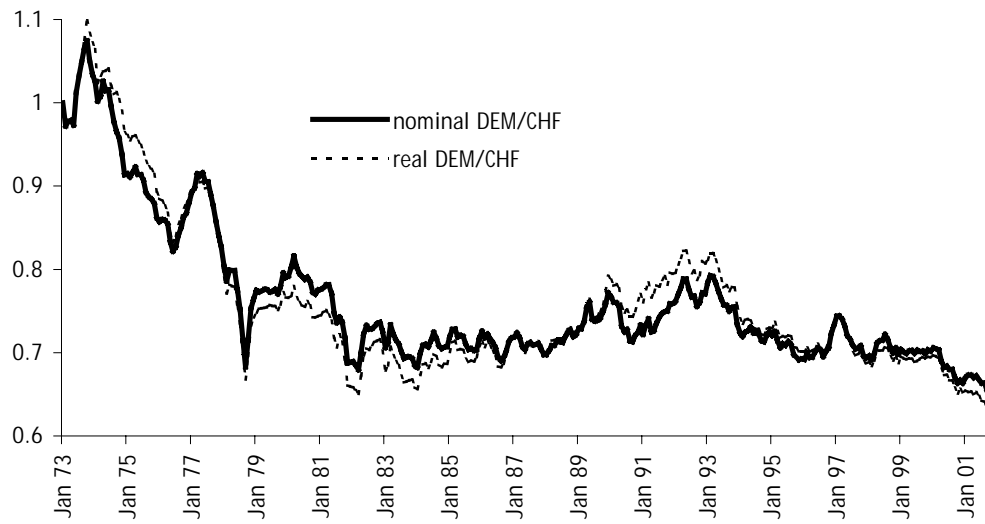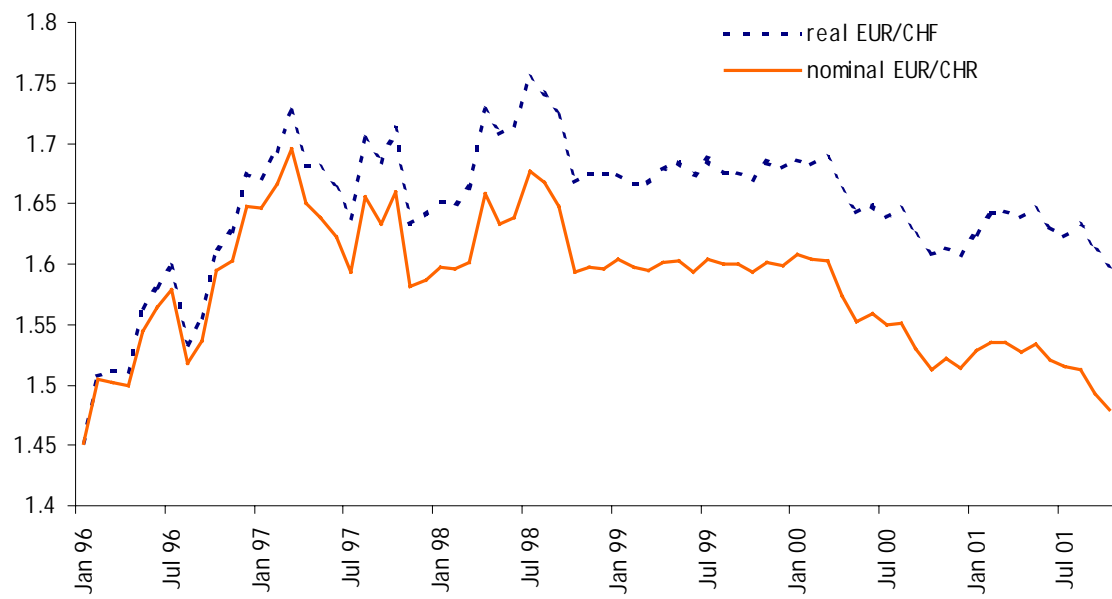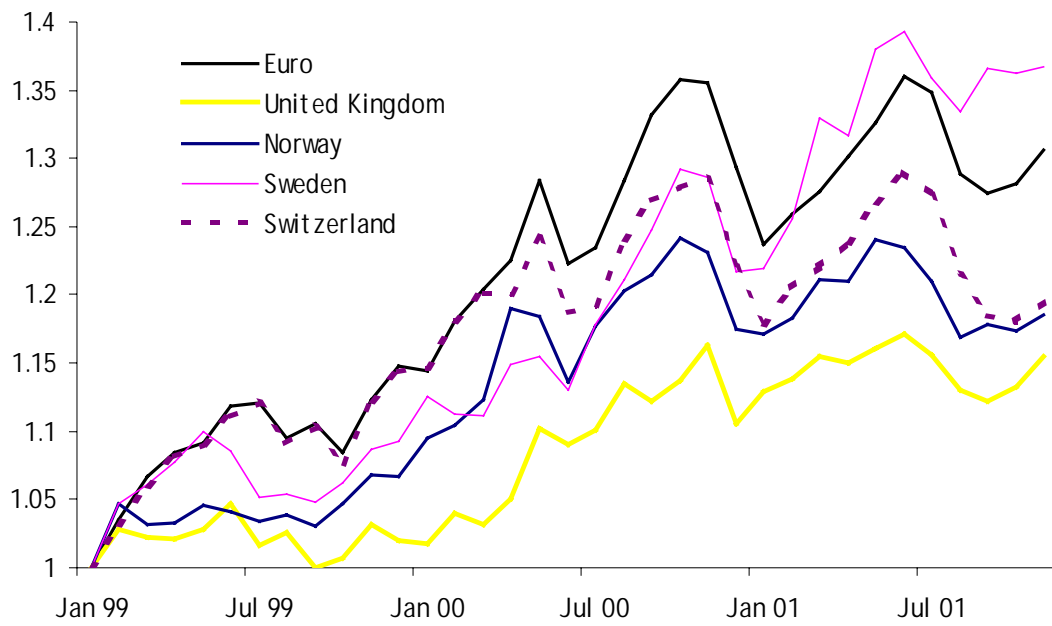(1973:1-2001:12)

Figure 3: CHF/EUR Exchange Rate (1996-2001)

Figure 4: Exchange Rate Developments against the US Dollar

Table 1: Monthly Exchange Rate Volatility (Standard Deviation)

Sample	Effective	CHF/DEM	CHF/USD	$\sigma^{USD}/\sigma^{EFF}$	$\sigma^{DEM}/\sigma^{EFF}$
1973:1-1998:12	1.53	1.33	3.32	2.17	0.87
1973:1-1979:12	1.80	1.77	3.65	2.03	0.98
1980:1-1989:12	1.42	1.21	3.38	2.38	0.85
1990:1-1998:12	1.36	1.04	2.98	2.19	0.76
1996:1-1998:12	1.27	1.00	2.53	2.53	0.78
1999:1-2001:12	0.86	0.69	2.46	2.86	0.80

Notes: Effective is the nominal effective exchange. σ^{USD} is the standard deviation of the CHF/USD exchange rate.

Table 2: Correlation Matrix of Monthly Change in the Exchange Rate

	Norway	Sweden	United Kingdom	Switzerland	Euro area
Norway	1.00	0.82	0.56	0.51	0.54
Sweden	0.82	1.00	0.54	0.48	0.49
United Kingdom	0.56	0.54	1.00	0.49	0.51
Switzerland	0.54	0.49	0.51	1.00	0.96
Euro area	0.51	0.48	0.49	0.96	1.00

Table 3: Share of Inter-Regional Trade between Outsiders and EMU-11 (1999)

To	EMU-11	Outsiders	Ave. Share of EU-11
From			
Denmark	40.8	26.7	1.3
Sweden	41.6	27.2	2.6
United Kingdom	51.2	7.0	10.4
Norway	43.7	36.1	0.8
Switzerland	51.4	10.4	3.0

Note: Figures are percent of trade from the individual five outsiders to EMU-11 and the combined five outsider countries. Ave. Share of EU-11 is the average trade of the EU-11 countries that goes to an outsider.

Table 4: Optimal-Currency-Area Indexes versus Germany

	1987	1991	1995
Denmark	0.063	0.06	0.074
Sweden	0.068	0.063	0.056
United Kingdom	0.099	0.094	0.089
Norway	0.078	0.078	0.077
Switzerland	0.038	0.03	0.023
EU-11	0.041	0.036	0.042

Notes: Source Bayoumi and Eichengreen (1997). Smaller index values denote convergence to Germany.

Table 5: Monthly Volatility Measures for Swiss and Euro-Area Variables: Post-1999

$VAR(\Delta CHF/EUR_1) = 0.452$	$VAR(\Delta CHF/EUR_2) = 0.518$
$VAR(\Delta P) = 0.061$	$VAR(\Delta P^*) = 0.038$
$VAR(i_1 - i_1^*) = 0.020$	$VAR(i_2 - i_2^*) = 0.028$
$VAR(\Delta i_1) = 0.067$	$VAR(\Delta i_1^*) = 0.050$
$VAR(\Delta i_2) = 0.051$	$VAR(\Delta i_2^*) = 0.028$
$VAR(\Delta i) = 0.065$	$VAR(\Delta i^*) = 0.043$

Notes: VAR(x) is the variance. P is the consumer price index, i is the three-month Libor, * denotes euro area, $_1$ denotes the period 1999:1-2000:6, and $_2$ denotes the period 2000:7-2001:12.

Table 6: Monthly Exchange Rate Volatility of 'Floaters': Euro Cross Rates

Exchange rate = x	1993:1-1995:12	1996:1-1998:12	1999:1-2001:12
USA	0.278	0.167	0.222
Norway	0.916	0.583	0.333
Sweden	0.222	0.555	0.133
Switzerland	0.361	0.417	0.833
United Kingdom	0.5	0.277	0.5

Note: Volatility is defined as $Prob(\Delta x < 1.0\%)$. For the period before 1999, the German mark is used.

Table 7: Monthly Interest Rate Volatility for 'Floaters'

interest rate = x	1993:1-1995:12	1996:1-1998:12	1999:1-2001:12
Euro-Germany	0.333	0.333	0.5
Norway	0.111	0.528	0.361
Sweden	0.333	0.333	0.5
Switzerland	0.433	0.219	0.472
United Kingdom	0.278	0.472	0.472

Note: Volatility is defined as Prob(Δx < 10 basis points). The interest rate is the three-month Libor. For the period before 1999, the German mark is used.