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The Effectiveness of the Interventions of the Swiss National Bank — An Event-Study Analysis

by

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April 2003

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JEL classification: F31, F33, G14
Keywords: Foreign exchange market, Central bank intervention, Swiss National Bank

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We use the event-study methodology to analyze the effectiveness of the foreign exchange market interventions conducted by the Swiss National Bank (SNB) during the period from 1986 through 1995. We find some evidence that the interventions of the SNB had an impact on exchange rate dynamics. The significance of this effect, however, depends on the direction of intervention. In general, the evidence suggests that the interventions of the SNB to strengthen the Swiss franc were more effective than its interventions to weaken the Swiss franc. We also find that the results of the tests for the effectiveness of the interventions of the SNB depend upon the length of the pre- and post-event window analyzed.

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1 Introduction

During the past three decades since the breakdown of the Bretton-Woods system, many central banks have continued to intervene occasionally in the foreign exchange markets in an attempt to influence exchange rate dynamics (Neely 2000). Given the widespread use of foreign exchange intervention by central banks, a number of authors have analyzed empirically the effectiveness of foreign exchange intervention in influencing exchange rate dynamics. Despite the fact that the empirical literature on foreign exchange intervention is somewhat fragmented, the general picture that emerges from this literature is that foreign exchange intervention is not particularly effective in influencing exchange rate dynamics (see, among others, Kaminsky/Lewis 1996, Weber 1996, Beine et al. 2002, and Fatum/Hutchison 2002).

In recent years, however, a number of authors have challenged this view (Humpage 1999, Sarno/Taylor 2001). In particular, Fatum (2000) and Fatum/Hutchison (2003) have argued that the time-series techniques most often used in the empirical literature may yield only imprecise information on the effectiveness of foreign exchange intervention. Their argument rests on the observation that, if intervention data are available at a daily frequency, the number of intervention days is relatively small as compared to the large number of non-intervention days. Thus, because intervention occur in general only from time to time, but exchange rates often tend to rally on a day-to-day basis, time-series techniques may not account for all features of the potential link between foreign exchange intervention and exchange rates dynamics. As an alternative to the time-series techniques commonly used in the empirical literature, they suggest the event-study methodology often applied in the empirical finance literature (see MacKinley 1997 for a survey).

In this paper, we use the event-study methodology to reexamine the effectiveness of the foreign exchange intervention against the U.S. dollar conducted by the Swiss National Bank (SNB) during the period from 1986 through 1995. Using the event-study methodology to reassess the effectiveness of the foreign exchange interventions of the SNB is interesting for at least three reasons.

The first reason is that the SNB is the central bank of a relatively small country. In consequence, only relatively few empirical studies have used the Swiss intervention data to assess the effectiveness of intervention activity (see, e.g., Dominguez/Frankel 1993). The vast majority of studies have been done for large-country central banks like the German Bundesbank or the U.S. Federal Reserve. Hence, the results we obtain for the SNB make it possible to study whether there are structural differences between the effectiveness of the foreign exchange intervention of large and small central banks.

The second reason is that a number of authors have used time-series techniques to study the effectiveness of the foreign exchange intervention of the SNB. As Gärtner (1987) – who estimates reaction functions of the SNB – points out, time-series studies are beleaguered by a potential simultaneity bias that arises because central banks may intervene in response to exchange rate movements and, at the same time, exchange rates may move because of the intervention. The event-study allows determining the effectiveness of central banks' intervention from a different angle and is one method to deal with this simultaneity problem.

The third reason is that a number of market-microstructure studies based on intra-daily exchange rate data have been conducted in recent years in order to study the short-run *effects* of the SNB interventions (Fischer/Zurlinden 1999, Payne/Vitale 1999, Pasquariello 2002). The picture that emerges

from these studies is that the interventions of the SNB had substantial short-run effects on exchange rate dynamics. In this paper, we use the event-study methodology to report results on medium-run *effectiveness* of the interventions of the SNB and, thereby, complement the results reported in the above mentioned studies.

We find some evidence that the interventions of the SNB had an impact on exchange rate dynamics. The significance of this effect, however, depends on the direction of intervention. In general, the evidence suggests that the interventions of the SNB to strengthen the Swiss franc were more effective than its interventions to weaken the Swiss franc. Moreover, our test results indicate that the effectiveness of the interventions of the SNB tends to depend upon the length of the pre- and post-event window analyzed. In general, we find that the interventions of the SNB were relatively effective if we study the exchange rate dynamics over a time span of several days after an intervention event. In contrast, if we focus on few days immediately after an intervention event, we find that the interventions of the SNB were not very effective. Thus, it seems that the intervention events unfolded their effects on the dynamics of the exchange rate only after a couple of days. Yet, we do not want to stretch this interpretation too far because the wider the post-event window the more likely is it that exchange rate dynamics do not only reflect the effects of the intervention event but the effects of other factors as well.

We organize the remainder of this paper as follows. In Section 2, we briefly describe our data set. In Section 3, we outline the event-study methodology. In Section 4, we present the results of our event study. In Section 4, we offer some concluding remarks.

2 The Data

We use data on the foreign exchange intervention conducted by the SNB during the period from January 1986 through December 1995. During this period of time, the SNB conducted 101 interventions against the U.S. dollar. The interventions carried out by the SNB are depicted in Figure 1 together with the U.S. dollar/Swiss franc exchange rate.

– Insert Figure 1 about here. –

Out of the 101 interventions, 68 interventions involved sales of U.S. dollar and 33 involved purchases of U.S. dollar (Table 1). For both U.S. dollar sales and U.S. dollar purchases, the mean absolute value of the SNB interventions was roughly 60 millions U.S. dollars. The majority of interventions conducted by the SNB involved less than 100 millions of U.S. dollars of foreign exchange reserves.

– Insert Table 1 about here. –

As depicted in Table 2, during the sample period we analyze in this paper, the unconditional probability of a SNB intervention was only roughly 4 percent. However, the conditional probability of a SNB intervention given that an intervention had already been conducted on the previous day was substantially higher (27 percent). This indicates that the interventions of the SNB tended to occur in clusters. This clustering of interventions is confirmed by visual inspection of Figure 1. As explained in more detailed in Section 3, the clustering of interventions indicates that it makes sense to treat the interventions belonging to the same intervention cluster as a single 'event'.

– Insert Table 2 about here. –

3 The Event-Study Methodology

We use the event-study methodology to analyze the effectiveness of the intervention conducted by the SNB. In order to setup the event-study methodology, we have to specify the design of the study . To this end, we have to define what constitutes an event. Furthermore, we must clarify which period of time surrounding an event is of particular interest for our purposes (that is, we have to define the event window). Finally, we must spell out how we measure the effectiveness of foreign exchange intervention.

We want to assure that our results can be easily compared with the findings reported in other empirical studies using the event-study methodology to study the effectiveness of central banks' foreign exchange intervention. For this reason, the design of our event study closely resembles the design of the event-study carried out by Fatum (2000) and Fatum/Hutchison (2003). Since we adapt the design of existing studies, our description can be relatively brief.

Because the interventions of the SNB tended to occur in clusters, we treat the interventions belonging to the same intervention cluster as a single 'event'. Thus, an event consists of a number of interventions in the same direction. An event starts on the day on which the first intervention of an intervention cluster is observed and an event ends on the day on which the last intervention of an intervention cluster occurs.

Because an intervention cluster may also contain no-intervention days, we have to be more specific about our definition of an intervention cluster. We assume that individual consecutive interventions belong to a single intervention cluster and, thus, to the same event if no more than fifteen consecutive no-intervention days separate the two interventions. Defining events in this way is reasonable because, as witnessed by Figure 1, consecutive interven-

tion days were in general either separated by only few no-intervention days (in which case the interventions belong to an intervention cluster) or an extended period of time (in which case the interventions belong to different intervention clusters).

Using our definition of an intervention cluster, we end up with 26 events. While 12 events represent intervention clusters where the SNB bought U.S. dollar to weaken the Swiss franc (upper part of Table 3) 14 events are identified where the SNB sold U.S. dollar to strengthen the Swiss franc (lower part of Table 3). Table 3 also depicts key summary statistics for these events. The tables give the days on which the events start as well as the days on which the events end. The table also contains information of the total amount of the intervention of the SNB during each event. Further, the table provides information on the number of intervention days and no-intervention days during each event.

– Insert Table 3 about here. –

The table also contains information on the average exchange rate changes as observed before and after each event. The period of time for which the pre-event (post-event) exchange rate returns are computed is known in the empirical finance literature as the pre-event (post-event) window. We can compare the pre-event and the post-event exchange rate returns in order to assess the effectiveness of the foreign exchange intervention policy of the SNB. For obvious reasons, the specific definition of the pre-event and post-event window is of crucial importance. For this reason, we use two alternative definitions of the pre- and post-event window in order to assess the robustness of our results. Specifically, we use a relatively short two-day as well as a relatively extended ten-day period as pre- and post-event window.

The advantage of the relatively short two-day event window is that the exchange rate movements in this event window are likely to reflect the effect of the foreign exchange intervention and are not due to the arrival of information unrelated to the intervention activity of the SNB. The shortcoming of the relatively short event window is that it might miss medium-run effects of the foreign exchange intervention. Such medium-run effects are likely to be reflected in the relatively longer ten-day event window.

Finally, we must introduce the criteria we use in order to assess the effectiveness of the foreign exchange intervention of the SNB. To this end, we use the *'direction'*, *'reversal'*, and *'smoothing'* criterion used by Fatum (2000) and Fatum/Hutchison (2003).

According to the *direction criterion* (see also Frankel 1994), the intervention policy of the SNB is effective if the exchange rate movement observed during the post-event window following an intervention cluster is in the same direction as the interventions observed during the intervention cluster. Thus, according to the direction criterion, purchases (sales) of U.S. dollar are effective if they result in a depreciation (an appreciation) of the Swiss fran.

Some authors like, for example, Humpage (1999) argue that such an effectiveness criterion only makes sense in the case the SNB pursues a leaning-against-the-wind rather than a leaning-with-the-wind policy. In general, the number of leaning-with-the-wind events among all events depends on the average exchange rate return observed before the event takes place. Hence, the number of leaning-with-the-wind events we have in our sample depends upon the definition of the pre-event window. As evidenced by Table 3, for the definitions of pre-event window we use in our study, the number of leaning-against-the-wind interventions is significantly larger

than the number of leaning-with-the-wind interventions. For example, when we apply the ten day pre-event window, 23 out of 26 events classify as leaning-against-the wind interventions.

In order to assure that we take Humpages' (1999) critique into consideration, we use an effectiveness criterion that accounts for the exchange rate trend that prevails before the intervention. Specifically, we do not only apply the direction criterion to evaluate all interventions in our sample but also apply this criterion to the leaning-against-the wind events only. If we do the latter, we use the term *'reversal criterion'* rather than 'direction criterion' to refer to our effectiveness criterion.

According to the *smoothing criterion*, the intervention policy conducted by the SNB is effective if it results in a 'smoothing' of the exchange rate. The smoothing criterion stipulates that the intervention policy of the SNB is effective if

- the condition for the direction criterion is satisfied, *or*
- sales (purchases) of U.S. dollars help to slow down the rate of appreciation (depreciation) of the Swiss franc in the post-event window as compared to the pre-event window.

Thus, the smoothing criterion is somewhat less restrictive than the direction criterion. Humpage (1999) has used a similar success criterion.

Based on these effectiveness criteria, we use the matched sample test and the non-parametric sign test for the median to assess the effectiveness of the foreign exchange intervention conducted by the SNB. Both tests are described in some detail in Fatum (2000) and Fatum/Hutchison (2003).

MacKinlay (1997) surveys a number of tests commonly used in event-study analyses.

In order to setup the matched sample test, we compute the mean value and the standard deviation of the difference between the average exchange rate returns observed in the pre- and in the post-event window. The null hypothesis of this test is that this difference is zero, i.e., the interventions are ineffective. The matched sample test is computed upon forming the ratio of the mean value and the standard deviation of the difference between the average exchange rate returns observed in the pre- and in the post-event window. The sampling distribution of this test is a t-distribution with degrees of freedom equal to the number of observations minus one.

In order to setup the non-parametric sign test for the median we assume that exchange rate changes are completely unpredictable, so that the probability of an effective intervention is 0.5 in the case of the direction criterion and 0.75 in the case of the smoothing criterion. We use a probability of 0.75 when we apply the smoothing criterion because, if exchange rate changes are purely random, we must take into consideration the fact that the probability of a change in the direction implied by the intervention is 0.5 and the probability that the change is not in the direction of the intervention but smaller than the change observed in the pre-event window is 0.25.

In order to assess the effectiveness of the interventions conducted by the SNB by means of the non-parametric sign test, we exploit the fact that the number of effective interventions among all events has a binomial distribution with a probability parameter equal to 0.5 (0.75). Upon using the cumulative distribution function of the binomial distribution, we determine the marginal significance of observing at least the actual number of effective interventions. If this test is statistically significant, this provides evidence that the observed

number of effective interventions (i.e., events) is not entirely attributable to the random fluctuations of the exchange rate.

4 Results

The results of the matched sample test are given in Table 4 and the results of the non-parametric sign test for the median are given in Table 5. As a robustness check we provide the results we obtain when we use a pre- and post-event window of two and ten days, respectively.

– Insert Tables 4 and 5 about here. –

Results indicate that the SNB was more effective in influencing exchange rate dynamics if it sold U.S. dollars. Thus, the probability of success was larger for interventions to strengthen the Swiss franc vis-à-vis the U.S. dollar than for interventions intended to lead to a depreciation of the Swiss franc vis-à-vis the U.S. dollar.

A further result is that the test results are not insensitive to the length of the pre- and post-event window. Specifically, the evidence for the effectiveness of the interventions of the SNB tends to be stronger if we use a ten-day event window. In contrast, if we use a relatively short two days post-event window, the test results suggest that the interventions of the SNB were rather ineffective.

On the one hand, the fact that the tests are significant when we use a relatively long time span as our post-event window suggests that, though it took a couple of days, the SNB interventions eventually exerted a significant impact on the dynamics of the exchange rate. On the other hand, the fact that we cannot find a similarly strong effect of the SNB interventions when we use a two days post-event window indicates that we should not stretch

this interpretation too far.

In fact, at least two interpretations of our results are possible. On the one hand side, it could be that the exchange rate fluctuations we observe when we assume a relatively short post-event window are relatively noisy measures of the effects of the interventions. This argument suggests that we should use the results we obtain when we assume a ten-days post-event window to draw the main conclusions of our analysis. On the other hand side, it may well be that the results we obtain when we use the ten-days post-event window are driven to a significant extend by noisy exchange rate fluctuations as well. This could be the case if the effect of the intervention event on exchange rate dynamics dies out quickly and the latter are thereafter driven mainly by other 'news' that are not linked to the intervention of the SNB.

It is also noteworthy that it is rather hard to explain in theoretical terms the asymmetry in the results we obtain for U.S. dollar purchases and U.S. dollar sales when using the ten days post-event window. In general, the theories commonly put forward to explain the exchange rate effects of central bank intervention do not feature such an asymmetry (see, e.g., Frenkel et al. 2002 for a survey). For example, both the signaling model and the portfolio model of exchange rate determination assume that, in principle, the effects of interventions to strengthen or to weaken the currency should have symmetric effects on the exchange rate.

In econometric terms, the fact that U.S. dollar sales tended to have a more significant effect on the exchange rate than U.S. dollar purchases may in part reflect the fact that the SNB heavily sold dollars in 1988 and 1989. As evidenced by Figure 1, a comparable massive intervention 'campaign' involving U.S. dollar purchases did not take place during the sample period we analyze in this paper. Of course, this argument rests on the assumption

that more massive intervention campaigns are more effective because, for example, a massive 'campaign' signals that the central bank is determined to bring the actual exchange rate in line with the implicit exchange rate 'target' it has in mind when intervening in the foreign exchange market.

5 Conclusions

The results of our event-study analysis indicated that the foreign exchange interventions conducted by the SNB during the period 1986 – 1995 tended to be more effective when the SNB sold U.S. dollars than when it purchased U.S. dollars.

The significance of this effect, however, depends on the direction of intervention. In general, the evidence suggests that the interventions of the SNB to strengthen the Swiss franc were more effective than its interventions to weaken the Swiss fran. We also find that the results of the tests for the effectiveness of the interventions of the SNB depend upon the length of the event window analyzed.

When interpreting the results of an empirical analysis of central bank foreign exchange intervention based on the event-study methodology, one should bear in mind the shortcomings of this methodology. One shortcoming of the event-study methodology we used in this paper is that using intervention clusters to define 'events' may cloud to a certain extent the effect of individual interventions on exchange rate dynamics. In this sense, the design of our event study does not allow exploiting fully the advantages of working with daily intervention data.

Another shortcoming of our event study is that its design allows shedding light on the effect of intervention on exchange rate return only. The

effect of intervention on exchange rate volatility is completely neglected. As discussed, e.g., by Dominguez (1998), the effect of intervention on exchange rate volatility provides important information with respect to the effectiveness of central bank interventions. Thus, one direction future research could take would be to use the event-study methodology to analyze the link between central bank interventions and exchange rate volatility.

The shortcomings of the event-study methodology must be balanced with its advantages. A core advantage of the event-study methodology is that it is straightforward to implement. Moreover, as compared to the more conventional time-series-based approach, the event-study methodology allows for an assessment of the effectiveness of foreign exchange intervention from a different angle. Thereby, it offers new insights into the effectiveness of central banks' foreign exchange interventions. Hence, if one seeks to paint a picture of the effectiveness of central banks' foreign exchange intervention as colorful as possible, combing the time-series approach with the event-study methodology seems to be a fruitful avenue for future research.

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Table 1: Size of Intervention

	All interventions	Sales	Purchases
Mean Absolute Value of Interventions	63.5	64.3	61.8
600 – 250.1	2	2	–
250 – 100.1	8	3	5
100 – 50.1	31	17	14
50 – 25.1	38	27	11
25 – 0	22	19	3
Total	101	68	33

Note: The interventions are measured in terms of millions of U.S. dollars.

Table 2: Probabilities and Conditional Probabilities

Probability of an Intervention ($I_t > 0$)	3.9 % (on 101 days out of 2,608)
Probability of Intervention Conditional upon Intervention on the Previous Trading Day ($I_t \neq 0 \mid I_{t-1} \neq 0$)	26.7 % (on 27 days out of 101)
Probability of a No-Intervention Conditional upon No-Intervention on the Previous Trading Day ($I_t = 0 \mid I_{t-1} = 0$)	97.0 % (on 2,432 days out of 2,507)

Note: I_t denotes an intervention dummy that takes the value of one on interventions days and zero else.

Table 3: Size of BoJ Interventions and the Press Reports of BoJ Interventions

Start of Event	End of Event	Level of Exchange Rate on First Day of Event	Total Amount of Intervention During Event	Number of Intervention Days / Days During Event	Average Returns Over 2 Days Before Event	Average Returns Over 2 Days After Event	Average Returns Over 10 Days Before Event	Average Returns Over 10 Days After Event
10/7/86	10/14/86	1.6295	135	2/6	–0.431	0.216	–1.20	3.71
4/27/87	5/5/87	1.4605	210	2/7	–2.297	0.446	–2.20	0.34
8/28/87	9/8/87	1.4922	115	4/8	–0.668	0.785	–4.77	1.58
10/28/87	1/13/88	1.444	885	15/56	–1.739	3.087	–3.79	2.32
4/14/88	4/15/88	1.374	80	2/2	0.657	0.211	2.30	1.52
11/17/88	11/18/88	1.4525	70	2/2	–1.271	–0.785	–3.26	–0.58
7/20/92	7/20/92	1.313	95	1/1	–2.210	0.683	–3.79	0.52
5/4/94	5/4/94	1.4105	50	1/1	–0.818	0.297	–3.03	–0.21
6/24/94	6/24/94	1.332	50	1/1	0.223	–0.301	–4.92	–0.75
3/3/95	3/3/95	1.216	150	1/1	0.308	–6.060	–1.76	–5.54
5/31/95	5/31/95	1.1675	100	1/1	0.526	0.128	–4.65	–0.99
8/15/95	8/15/95	1.224	100	1/1	1.349	0.204	3.71	–1.07
6/28/88	8/25/88	1.498	–700	11/43	1.844	0.191	4.27	–0.61
9/26/88	9/26/88	1.5936	–30	1/1	0.088	–0.226	1.44	–0.86
1/9/89	2/6/89	1.5575	–410	8/21	1.969	–0.345	3.31	–2.31
3/16/89	3/29/89	1.6115	–165	4/10	0.717	1.089	2.55	1.39
4/28/89	6/16/89	1.6735	–725	12/36	0.884	1.098	0.71	–2.47
8/11/89	10/11/89	1.6725	–450	14/44	0.258	–0.510	1.42	–3.53
12/27/89	1/4/90	1.536	–590	2/7	0.097	–1.187	–1.73	–1.54
3/5/90	3/7/90	1.5	–40	2/3	1.464	0.371	1.33	0.94
3/11/91	3/27/91	1.3705	–410	7/13	1.402	–0.655	5.65	–2.12
4/23/91	4/24/91	1.4595	–70	2/2	2.599	0.658	3.35	–0.33
6/10/91	6/10/91	1.5118	–25	1/1	1.512	1.360	4.33	1.43
7/12/91	7/12/91	1.5499	–50	1/1	1.031	0.746	2.57	–2.28
8/19/91	8/19/91	1.551	–25	1/1	1.438	–1.822	2.13	–1.46
3/6/92	3/11/92	1.517	–685	2/4	1.135	–0.066	2.30	–0.57
Total			–2,335	101/274				

Table 4: The Results of the Matched Sample Test

PANEL A: Ten Days Pre- and Post- Event Window

	No. of events		t-test
Sales	14		
Average returns in the pre-event window		2.404	
Average returns in the post-event window		-1.022	
Average difference in returns		-3.426	
Standard deviation		2.142	-1.599
	No. of events		t-test
Sales (only leaning against the wind)	13		
Average returns in the pre-event window		2.722	
Average returns in the post-event window		-0.983	
Average difference in returns		-3.704	
Standard deviation		1.945	-1.901
	No. of events		t-test
Purchases	12		
Average returns in the pre-event window		-2.280	
Average returns in the post-event window		0.071	
Average difference in returns		2.351	
Standard deviation		3.619	0.650
	No. of events		t-test
Purchases (only leaning against the wind)	10		
Average returns in the pre-event window		-2.281	
Average returns in the post-event window		0.040	
Average difference in returns		3.377	
Standard deviation		2.845	1.187

PANEL B: Two Days Pre- and Post-Event Window

	No. of events		t-test
Sales	14		
Average returns in the pre-event window		1.174	
Average returns in the post-event window		-0.031	
Average difference in returns		-1.124	
Standard deviation		1.048	-1.072
	No. of events		t-test
Purchases	12		
Average returns in the pre-event window		-0.531	
Average returns in the post-event window		-0.091	
Average difference in returns		0.440	
Standard deviation		2.753	0.160
	No. of events		t-test
Purchases (only leaning against the wind)	7		
Average returns in the pre-event window		-1.348	
Average returns in the post-event window		0.676	
Average difference in returns		2.023	
Standard deviation		1.556	1.300

Table 5: The Results of the Non-Parametric Sign Test for the Median

PANEL A: Ten Days Pre- and Post-Event Window

Direction	Number of Events	Number of Successes (a)	P-value (b)
USD Purchases	12	6	61.28%
USD Sales	14	12	0.65%
Total	26	18	3.78%
Reversal	Number of Events	Number of Successes (a)	P-value (b)
USD Purchases	10	5	62.30%
USD Sales	13	11	1.12%
Total	23	16	4.66%
Smoothing	Number of Events	Number of Successes (d)	P-value (e)
USD Purchases	10	9	24.40%
USD Sales	13	13	2.38%
Total	23	22	1.16%

PANEL B: Two Days Pre- and Post-Event Window

Direction	Number of Events	Number of Successes (a)	P-value (b)
USD Purchases	12	9	7.30%
USD Sales	14	7	60.47%
Total	26	16	16.35%
Reversal (c)	Number of Events	Number of Successes (a)	P-value (b)
USD Purchases	7	6	6.25%
USD Sales	14	7	60.47%
Total	21	13	19.17%
Smoothing (c)	Number of Events	Number of Successes (d)	P-value (e)
USD Purchases	7	7	13.35%
USD Sales	14	12	28.11%
Total	21	19	7.45%

Note:
(a) Intervention is successful if the sale (purchase) of U.S. dollar is followed by an U.S. dollar depreciation.
(b) Based on a binomial probability distribution with the probability of an individual success of 50 %.
(c) The SNB pursuing a "leaning against the wind" intervention policy.
(d) Intervention is successful if the sale (purchase) of U.S. dollar is followed by a U.S. dollar depreciation (appreciation) or a slowing of U.S. dollar appreciation (depreciation).
(e) Based on a binomial probability distribution with the probability of an individual success of 75 %.