Carry trade and negative interest rates in Switzerland

Bruno Thiago Tomio[a,b,*], Guillaume Vallet[b]

[a] *Universidade de Blumenau, Rua Antônio da Veiga, 140, Blumenau, 89030-903, Brazil*
[b] *Université Grenoble Alpes, 1241 rue des Résidences, Saint-Martin-d'Hères, 38400, France*

Abstract

Recently, the Swiss National Bank (SNB) has surprised the world of central banking by anchoring the Swiss franc to the euro and setting negative policy rates. This article aims to investigate the interactions of the Swiss carry trade and the related financial variables in both periods of positive and negative policy rates in Switzerland. Using a structural vector autoregressive model (SVAR), we study the behaviour of the carry trade based on five financial variables: nominal exchange rates (USD/CHF), interest rate differentials between Switzerland and the US, market sentiment in the US, Swiss stock market index, and US stock market index. We attained evidence that the Swiss franc acted as a target currency during the period of positive policy rates in Switzerland. With negative interest rates, there is a reinforcement of the CHF as a funding currency. We reach the conclusion that, as long as instability in the International Monetary System prevails, the Swiss franc will continue to play the role of safe haven currency. This role is not problematic only for Switzerland but also for other countries, due to systemic risks posed by the intertwinement of financial markets. The SNB would benefit from strengthening its macro-prudential supervision by establishing new instruments capable of forecasting the impact of trends in financial variables on its monetary policies.

1. Introduction

This paper aims to investigate the relationships between the Swiss franc (CHF) carry trade and the related financial variables with a focus on the financial markets of Switzerland and the United States (US). Unlike most of the literature on the currency carry trade, which focuses on hypothetical portfolios, we analyse the carry trade with weekly data from the U.S. Commodity Futures Trading Commission (CFTC). As a starting point, currency carry trade consists of borrowing money in countries with low interest rates (funding currency) and investing in countries with high interest rates (target or investment currency).

*Corresponding Author

Email addresses: bttomio@furb.br (Bruno Thiago Tomio), guillaume.vallet@univ-grenoble-alpes.fr (Guillaume Vallet)

Although the uncovered interest rate parity hypothesis rests on the idea that the depreciation of the investment currency should offset the gain in interest rate differential, evidence indicates that it is not always the case (Brunnermeier et al. 2008). This is the case for the Swiss franc, whose fluctuations make it appear as a "strange animal" (Jochum and Savioz 2005). The interest in the case of the Swiss franc is two-folded. First, it is a safe haven currency and a well-known funding currency, depending on the period considered. The Swiss franc plays the role of safe haven currency in case of a turmoil of different kinds, leading to a rise in the demand in Swiss franc-denominated assets. In this case, the Swiss franc may be seen as an investment currency (Ranaldo and Söderlind 2010). However, the Swiss franc can also act as a funding currency because Switzerland has an "interest rates bonus" (Kugler and Weder 2002). Historically, such a bonus means that both short and long real interest rates are lower than in other countries. Such a monetary framework gives incentives to investors to borrow and to contract debts labelled in Swiss francs. Secondly, the Swiss National Bank's monetary policy of negative interest rates may impact other countries besides Switzerland. We consider two questions about the behaviour of the carry trade, considering both different periods of monetary policy in Switzerland: positive and negative policy interest rates. The first refers to the determination of the financial factors that hold important roles in explaining the Swiss franc carry trade. In this paper, we restrict the analysis to the following financial variables: nominal exchange rates (USD/CHF), policy interest rates in Switzerland, market sentiment in the US, Swiss stock market index, and US stock market index. In order to address the first question, we investigate these financial variables shocks on the carry trade. Second, we reflect on the consequences of the unwind of Swiss franc carry trade activities. Specifically, we are interested in how carry trade shocks the related financial variables.

Fig. 1 shows the movements of carry trade, the US policy interest rate, and Switzerland's policy rate along the periods of positive (PI period) and negative (NI period) interest rates. The carry trade ratio divides the short positions by long positions in Swiss franc. If the ratio is between zero and one (green shaded area in Fig. 1), long positions exceed short positions. In this case, following Gubler (2014), CHF would be acting as a target currency. Conversely, when the carry trade ratio is higher than one, CHF would be the funding currency in the carry trade strategy.

Roughly from the end of 2016, as shown in Fig. 1, the carry trade ratio shows evidence of the role of funding currency for the Swiss franc. This behaviour is present in the majority of time in the NI period. By setting negative policy rates in Switzerland, the SNB has potentialised carry trade activities in Swiss franc. Additionally, the innovative monetary policy increases the historical role of the CHF as a safe haven currency.

2. Literature review

From the investors' perspective, the main goal of the carry trade strategy is to profit from interest rate differentials between countries. This is only possible

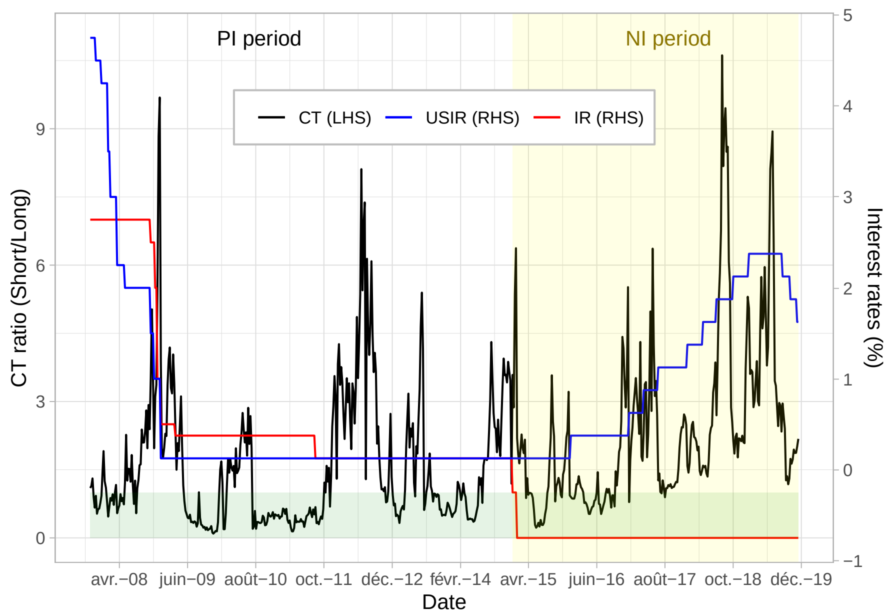


Figure 1: CT ratio, US policy rate, and Switzerland's policy rate, from October 2017 to November 2019
Source: U.S. Commodity Futures Trading Commission; Bank for International Settlements.

if the hypothesis of uncovered interest rate parity (UIP) does not hold. According to the UIP, the interest rate differential between one specific country and one reference region must be equal to the expected depreciation of the specific country's currency. As widely documented by the literature, the UIP is repetitively invalidated (see Farhi and Gabaix 2016). This violation of the uncovered interest rate parity is referred to as the "forward premium puzzle", making the carry trade profitable on average (Brunnermeier et al. 2008). Therefore, the failure of one of the main pillars in international finance theory is the primary driver of the carry trade.

The literature on carry trade is quite extensive. There is a large body of empirical papers on hypothetical portfolios using carry trade strategies. Overall, the data used to investigate these portfolios is related to the estimated profitability of carry trade (e.g. Burnside et al. 2007; Clarida et al. 2009; Darvas 2009; Menkhoff et al. 2012; Cenedese et al. 2014; Doskov and Swinkels 2015). By focusing on the profits, the impacts of the carry trade investments on the domestic economies and the international financial system stability are often neglected. Specifically, it is worth noting that those as mentioned earlier "forward premium puzzle" often has a 'side effect', in the sense it is accompanied by dramatic exchange rate fluctuations beyond the fundamental levels of the exchange rate. Clearly, carry trade is part of the explanation of foreign exchange rate puzzles (Spronk et al. 2013). This could be explained by the fact that carry traders find constraints regarding their speculative investments, leading them to move from a place to another. All in all, there is a high likelihood of crash risk, either for investment currencies or for speculators because of the losses in carry trade positions. More broadly, this increases global risk (Brunnermeier et al. 2008).

Furthermore, with data on broader flows of capitals, another collection of the literature explores the negative impacts of the carry trade (e.g. Dodd and Griffith-Jones 2007; Spronk et al. 2013; Fritz and Prates 2014; Prates and Paula 2017; Goda and Priewe 2019). Empirically, it is a problematic approach. With balance of payments data, it is not possible to distinguish carry trade from other types of flows. In this sense, Agrippino and Rey (2013) present a similar approach, even though they use data on banking lending provided by the Bank of International Settlements.

With the use of data on speculative positions in the US futures market, our approach is closely related to Nishigaki (2007). Therefore, our paper explores the impacts of the carry trade with real data, not estimated carry trade returns. This distinguishes our paper from both previous approaches.

Moreover, to the best of our knowledge, this is the first paper that investigates the Swiss franc carry trade with data from the CFTC in the period of negative policy interest rates. Hameed and Rose (2018) conclude that negative interest rates in Switzerland do not affect carry trade returns. Additionally, they find little evidence that the negative interest rates impact exchange rate behaviour. Therefore, SNB's belief that the impact of the negative interest rate policy would be via the exchange rate channel, as pointed by Jordan (2016), is contradicted. More in line with our hypotheses, Kay (2008) points out that negative policy interest rates encourage carry trade, which may also increase risks with their messily unwind.

3. Methodology

3.1. Data specification

Based on the framework of the structural vector autoregressive (SVAR) model in Nishigaki (2007), we considered the following variables, as shown in Table 1. Based on the SNB monetary policy, two samples are created. For the PI period, it goes from October 2, 2007, to December 16, 2014. Moreover, the starting date matches the beginning of a monetary loosening in the US. On the 18th of December 2014, the SNB surpassed the zero lower bound by setting the policy rate is -0.25% per year. Our NI period ranges from December 23, 2014, to November 12, 2019. Moreover, to account for the recent change in the monetary policy in the US, a dummy (QE2) is created. This is equal to one from August 6, 2019, through November 12, 2019.

As a proxy of the carry trade, we use the weekly data of Swiss franc futures contracts in the US financial market by non-commercial traders. According to the Commodity Futures Trading Commission (2020), traders are classified either as commercial or non-commercial. After filling a statement and being

Table 1: Description of variables

Variable	Definition	Source
CT	Ratio of short positions over long positions (Short/Long)	CFTC
ER	Nominal exchange rates, USDCHF	BIS
IRD	Difference between the policy interest rate in Switzerland and the policy interest rate in the United States	BIS
VIX	Market sentiment, CBOE DJIA Volatility Index	FRED
SM	Swiss Market Index, ^SSMI (Swiss stock market)	Yahoo Finance
SMUS	S&P 500, ^GSPC (US stock market)	Yahoo Finance

Note: See Table A1 (Appendix) for the descriptive statistics

verified, a trading entity is classified as commercial if it uses futures contracts for hedging, as defined in the CFTC Regulation 1.3, 17 CFR 1.3(z). Even being a naïve rule, as pointed out by Hartzmark (1987, p. 1296), all other traders that do not qualify as hedgers are classified as non-commercial or speculators. There is a vast literature that investigates the behaviour of speculators with the CFTC data (e.g. Houthakker 1957; Chalupa 1982; Goldsteing 1983; Chang et al. 1997; Adrangi and Chatruth 1998; Klitgaard and Weir 2004; Mogford and Pain 2006; Galati et al. 2007; Nishigaki 2007; Brunnermeier et al. 2008; Gubler 2014; Mulligan and Steenkamp 2018; Kang et al. 2020).

There are two types of positions in futures contracts: short and long. A short (long) futures position is an obligation to sell (buy) the foreign currency at a contracted rate and specified future date. As a funding currency, carry traders take short positions on Swiss francs. By borrowing in Swiss francs, with low interest rates, long positions are taken in target currencies that present higher interest rates. In our present study, we use a ratio of short to long positions (CT). Therefore, in the day t of a specific week, we divide the given number of contracts for each type of position. The advantage of the ratio is the possibility of comparison with other countries. Moreover, a higher (lower) CT means an increase (decrease) in Swiss franc carry trade activity.

Nevertheless, there are some limitations with our proxy of the carry trade, as highlighted by Galati et al. (2007), Curcuru et al. (2011), and Bank for International Settlements (2015). The first caveat is about the trading activity. Even being classified as a speculator, not all contracts are used in a carry trade strategy. Second, over-the-counter contracts, which are not subject to CFTC reporting requirements, are largely used in carry trade activities. Third, exchanges represent only a small fraction of the overall foreign exchange market activity, as pointed out by the BIS Triennial Bank Survey of Foreign Exchange and Derivative Market Activity.

As mentioned by market participants, CFTC data tends to be indicative of the trend of carry trade activity (Bank for International Settlements 2015). Furthermore, it is the best public data on carry trade.

Additionally, the reporting day t of the CFTC data is used as the reference for the other variables.

3.2. The SVAR model with the Toda-Yamamoto approach

To have "stronger statements about causation and timing," as pointed by Becketti (2013), we structure an SVAR model to investigate the impacts of carry trade in Switzerland. This model follows the equation:

$$y_t = \phi_1 y_{t-1} + \cdots + \phi_p y_{t-p} + A^{-1} B v_t \tag{1}$$

The first element, y_t, represents a vector of the endogenous variables in our system of equations. For the constants, we exclude its vector for simplicity. The matrices of coefficients are given by ϕ_i. Matrices A and B are introduced to add structural parameters. In matrix A, we introduce additional contemporaneous endogenous variables to each equation. Matrix B simplifies the error structure. In this sense, the matrix of random disturbances is transformed into v_t, with uncorrelated elements. The SVAR follows this specification:

$$A\epsilon_t = Bv_t \tag{2}$$

Alternatively, following the details and ordering put by Nishigaki (2007), we have:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ g(VIX,IRD) & 1 & 0 & 0 & 0 & 0 \\ g(CT,IRD) & g(CT,VIX) & 1 & 0 & 0 & 0 \\ g(ER,IRD) & g(ER,VIX) & g(ER,CT) & 1 & 0 & 0 \\ g(SMUS,IRD) & g(SMUS,VIX) & g(SMUS,CT) & g(SMUS,ER) & 1 & 0 \\ g(SM,IRD) & g(SM,VIX) & g(SM,CT) & g(SM,ER) & g(SM,SMUS) & 1 \end{bmatrix} \begin{bmatrix} \epsilon_{IRD,t} \\ \epsilon_{VIX,t} \\ \epsilon_{CT,t} \\ \epsilon_{ER,t} \\ \epsilon_{SM,t} \\ \epsilon_{SMUS,t} \end{bmatrix} = Bv_t \tag{3}$$

Additionally, we follow Chen et al. (2016) to estimate the SVAR model with the method of Toda and Yamamoto (1995). As mentioned by Amiri and Ventelou (2012), the Toda-Yamamoto approach avoids possible misspecification of the models in the presence of non-stationary variables. Most importantly, by using this approach, we can capture long-term information with level variables.

The application of this technique is straightforward. First, we apply unit roots tests developed by Clemente et al. (1998). These tests consider one structural break with unknown breakpoints. We chose the innovative outlier (IO) model since it is more accurate to our data (gradual shifts in the mean of the series). Results are presented in Table 2.

Table 2: Results of unit root test

	PI period						NI period					
Variable	CT	ER	IRD	VIX	SM	SMUS	CT	ER	IRD	VIX	SM	SMUS
t-Statistic	-3.92	-4.54	-7.86	-4.1	-3.94	-2.34	-4.94	-4.16	-3.03	-4.6	-2.74	-1.75
I(d)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(0)	I(1)	I(1)

Note: See Table A2 (Appendix) for more details on these tests.

Moreover, variables that are not stationary in levels must be added as lagged exogenous variables in the SVAR model. The number of lags of these variables is specified by d plus p. By doing this, we are proceeding with a modified Wald test (MWald test). Therefore, as put by Toda and Yamamoto (1995), "it is clearly desirable to have a testing procedure which is robust to the integration and cointegration properties of the process so as to avoid the possible pretest biases."

Second, we need the maximum lag length p of the SVAR model. In order to choose p, we first generated tests for the optimal lag length. Therefore, one test statistic (likelihood-ratio - LR) and three information criteria (Akaike - AIC, Hannan and Quinn - HQIC, and Schwarz's Bayesian – SBIC) were considered. Following these results, we proceeded with the Lagrange-multiplier (LM) test for residual autocorrelation (see Table A3 and Table A4 in Appendix). If the optimal lag length order did not present the autocorrelation problem, we carried the stability test (eigenvalue stability condition). If the optimal lag length order failed the autocorrelation test, we chose the lag order with the highest p-value (lowest probability of autocorrelation). Thus, the procedure continues with the stability test at the end. Still, the test to verify the optimal lag length order is not sufficient to choose the correct lag order. The lag order p must not have autocorrelated residuals. Additionally, the estimated model with the chosen lag must succeed in the stability test (no eigenvalue larger than one).

The structure of the exogenous variables of the final estimated models is given in Table A5 (Appendix). We explore the results of these models in the next section.

4. Empirical results and discussion

By analysing the impulse response functions of the estimated SVAR model, we can assess the relationship between carry trade and financial variables during the periods of positive interest rates (PI) and negative interest rates (NI).

In order to address our question, we start with the analysis of how much of the carry trade fluctuations are explained by the financial variables. By decomposing the carry trade variances in six components, we can analyse the contribution of each financial variable. Table 3 shows the results of the variance decompositions for each period.

In the short-term, four weeks after the initial shock, the forecast-error variance in the carry trade is almost exclusively due to uncertainty in the carry trade equation (90.54% in the PI period; 87.44% in the NI period). Differences are very subtle; results do not differ much from one period to the other. Notably, there are changes in the variables IRD, VIX, and ER between the periods. In comparison to the PI period, the error in the IRD and ER equations increase their contribution to the variance of CT during the NI period. Also, VIX decreases its attribution.

However, in the following periods, the results of the variance decomposition of the carry trade equation differ sharply. Twenty weeks ahead, in the PI period, 36.25% of the variance is attributed to the error in the VIX, ER, and SMUS equations (14.30%, 13.13%, and 8.82%, respectively). As for the NI period, SMUS, ER, IRD, and SM contribute roughly to half (49.91%) of carry trade fluctuations (19.71%, 11.79%, 9.70%, and 8.71%, respectively).

Table 3: Variance decompositions for the periods with positive (PI) and negative (NI) interest rates

		PI period						NI period					
		Response											
Impulse	Step	IRD	VIX	CT	ER	SMUS	SM	IRD	VIX	CT	ER	SMUS	SM
IRD	4	94.14	0.39	0.26	0.73	2.68	1.79	94.11	2.20	0.34	0.39	1.36	1.60
	8	84.91	0.37	1.51	3.33	5.21	4.67	86.03	3.48	1.76	1.67	5.81	1.25
	12	78.01	0.30	2.43	6.83	5.79	6.65	75.65	2.85	3.15	2.45	14.02	1.88
	16	73.05	0.27	2.66	10.59	5.59	7.84	64.05	2.72	4.30	2.43	22.62	3.89
	20	69.24	0.26	2.54	14.25	5.22	8.49	53.24	3.07	5.13	2.10	29.72	6.75
VIX	4	0.13	93.26	0.04	0.10	5.44	1.02	1.11	95.16	0.16	2.00	1.57	0.00
	8	0.50	84.58	0.82	0.57	11.31	2.22	3.58	79.68	0.31	2.69	13.48	0.25
	12	1.06	80.30	1.83	1.07	13.05	2.70	4.61	67.80	0.62	2.27	23.19	1.50
	16	1.59	78.54	2.31	1.40	13.33	2.84	4.52	59.31	1.50	1.95	29.01	3.70
	20	2.02	77.84	2.43	1.57	13.28	2.85	4.15	52.65	2.35	1.70	32.83	6.32
CT	4	2.55	3.42	90.54	1.23	2.12	0.14	4.35	0.12	87.44	6.50	1.02	0.56
	8	2.08	8.45	77.54	4.98	6.29	0.66	5.51	0.28	76.28	14.60	1.48	1.86
	12	2.07	11.93	67.85	8.60	8.36	1.19	8.66	0.37	66.25	15.56	5.44	3.71
	16	2.35	13.61	62.38	11.28	8.87	1.51	10.01	0.60	57.14	13.91	12.28	6.07
	20	2.75	14.30	59.36	13.13	8.82	1.64	9.70	1.13	48.96	11.79	19.71	8.71
ER	4	0.04	2.61	6.58	90.17	0.17	0.42	2.87	3.08	0.41	93.13	0.08	0.43
	8	0.24	3.61	7.04	87.70	0.35	1.06	6.31	3.00	0.49	88.47	1.02	0.71
	12	0.70	4.35	7.10	86.06	0.38	1.40	7.81	2.87	0.48	84.63	3.04	1.16
	16	1.34	4.82	7.21	84.76	0.36	1.52	8.06	2.83	0.60	80.86	5.76	1.89
	20	2.06	5.11	7.39	83.60	0.32	1.52	7.86	2.94	0.84	76.80	8.63	2.91

Table 3: Variance decompositions for the periods with positive (PI) and negative (NI) interest rates *(continued)*

		PI period						NI period					
		Response											
Impulse	Step	IRD	VIX	CT	ER	SMUS	SM	IRD	VIX	CT	ER	SMUS	SM
SMUS	4	0.10	55.16	1.62	0.12	42.23	0.76	0.19	64.61	0.70	2.05	31.99	0.46
	8	0.37	50.94	5.35	0.34	41.19	1.81	1.02	60.63	3.19	3.09	30.10	1.97
	12	0.73	49.17	7.69	0.60	39.44	2.37	1.55	58.56	4.28	2.99	29.19	3.43
	16	1.06	48.49	8.70	0.77	38.38	2.60	1.68	57.46	4.50	2.92	28.96	4.49
	20	1.34	48.26	9.01	0.86	37.86	2.67	1.70	56.66	4.51	2.87	29.02	5.23
SM	4	0.12	41.09	0.92	7.76	30.21	19.90	0.87	42.37	3.10	12.16	3.78	37.72
	8	0.13	40.13	4.90	6.12	37.52	11.20	2.65	33.90	5.41	11.85	7.64	38.54
	12	0.25	39.12	8.70	5.28	37.84	8.80	4.47	29.32	5.37	12.48	11.57	36.79
	16	0.37	38.37	11.05	5.02	37.10	8.09	6.21	27.48	4.93	12.96	12.87	35.56
	20	0.45	37.89	12.24	5.05	36.53	7.85	7.60	26.67	4.66	13.14	12.98	34.95

By switching from positive policy rates to negative ones, the SNB contributed to the change in the relationship between carry trade and financial factors. Notably, in the NI period, VIX has a negligible impact in CT. Another difference is the substantial impact of Swiss stock prices. Similarly to the PI period, US stock prices and the exchange rate still influence the carry trade meaningfully in the period of negative interest rates.

Even though it is not a research question of this paper, it is worthwhile showing the results for the carry trade contribution to the fluctuations of the financial variables. As Table 3 displays, the error on the carry trade equation has tiny contributions to the forecast-error variance of the financial variables. Interestingly, in the short-term (4 weeks), CT contributes to 6.58% to the ER fluctuations in the PI period. Also, four weeks ahead, 3.10% of the Swiss stock prices fluctuations are linked to the carry trade in the NI period. Going further, 20 weeks after the initial shock, CT has different contributions to IRD in both periods (2.54% in the PI period; 5.13% in the NI period). Additionally, other significant contributions by CT are ER (7.39%) in the long-term in PI period and SM (4.66%) and SMUS (4.51%) in the NI period.

Furthermore, to continue the investigation of our questions, we assess the impulses response functions graphically. Fig. 2 and 3 show the impacts of financial variables impulses on carry trade during the periods of positive and negative interest rates in Switzerland, respectively.

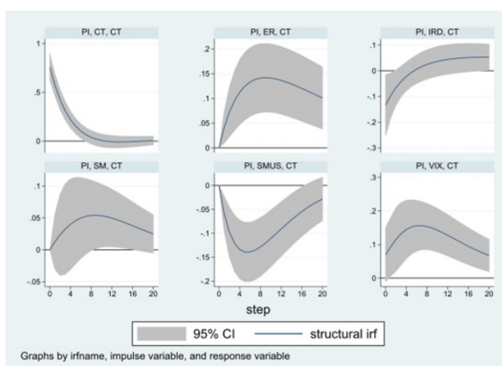


Figure 2: Structural Impulse Responses of NP, PI period

During the PI period, Fig. 2 display the impulse responses results of CT to one standard deviation of all financial variables shocks. We find that carry trade responds to exchange rates shocks positively. An increase in ER means the Swiss franc depreciates in relation to the US dollar. Therefore, the profit-seeking logic of the carry trade operation with the CHF as a funding currency is validated. By borrowing in Swiss francs, the carry trader would profit more with its devaluation.

Accordingly, IRD shocks have a significative negative influence in the short-run. An increase in the interest rate differential means an increased gap between the policy rates in Switzerland and the US. Therefore, the effect on an increase

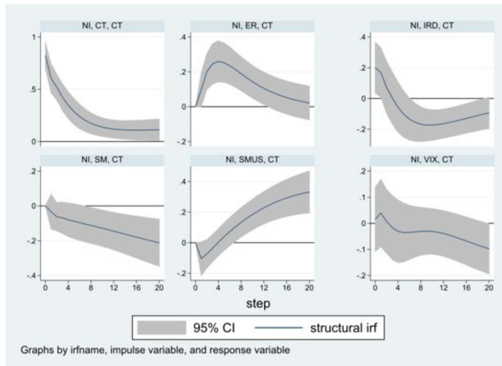


Figure 3: Structural Impulse Responses of NP, NI period

in IRD is the decrease in the carry trade activity with Swiss francs. Apart from this slight non-alignment with the typical carry trade behaviour, the result is confirmation of a possible period of target currency for the CHF.

Meaningfully, during the PI period, the policy rate in Switzerland exceeded the policy rate in the US only for sixteen weeks (over a total of 377 weeks). Additionally, for several weeks, both rates presented the same value (179 weeks), presenting an IRD equal to zero. Not surprisingly, we only find a statistically significant result in the very short-term. Furthermore, the target currency classification is also supported by the number of weeks that short positions were smaller than long positions (the green area in Fig. 1). During the PI period, the carry trade ratio presented a value between 0 and 1 for 179 weeks. Whereas in the NI period, 56 weeks.

Moreover, substantial evidence was found for the effect of SMUS on CT. By showing an inverse relationship, the results show that carry trade activity would increase in a bearish US stock market. However, this substitution effect needs to be interpreted with caution since the presence of diversified portfolios to diminish risk is a rule in the financial market. Results of the VIX shocks on CT are illustrative in this direction. An increase in the market sentiment would increase carry trade activity. As for Switzerland's stock market prices shocks, results point out to be a positive relationship with CT between 8 to 16 weeks ahead of the initial shock. Therefore, we reinforce our hypothesis of the Swiss franc as a target currency in this period.

As Fig. 3 shows, results change significantly in the period of negative interest rates. Nonetheless, there are some similarities. First of all, concerning the exchange rate shock, results remain the same. A larger/smaller exchange rate (USD/CHF) could increase/decrease the activity of Swiss franc carry trade. As expected, as the Swiss franc depreciates, carry traders would increase their activity. Moreover, the SNB is explicitly pushing for devaluations of the Swiss franc. By adding the negative interest rates, profits may be very probable in carry trade operations.

As for the IRD shocks, they present significant results in the first two-weeks ahead of the initial shock, as well as after six weeks onwards. Initially, an increase in the interest rate differential impacts the carry trade positively. After a couple of weeks, the effect is reversed. During the NI period, the policy rate in Switzerland stays practically stable at -0.75%.

Consequently, movements in the IRD are due to the monetary policy of the Federal Reserve. In the US, the policy rate remained at 0.125 for 366 weeks. The first hike after this long period occurred on the 14th December 2016, when the Fed chairwoman Janet Yellen announced a 0.25% increase. Several other hikes followed on until the start of the recent monetary easing movement. Not surprisingly, the peak of the carry trade ratio in our data is reached during these increases (10.61 on the 24th July 2018). On the 31st July 2019, Fed chairman Jerome Powell realised the first cut in the US policy rate since the 2008 crisis with a 25 basis points decrease.

The most striking results emerge from the stock markets shocks, both SM and SMUS. In the short-term, up to 6-7 weeks ahead of the initial shock, results are not significant for both. Further steps ahead, the SM shock impacts carry trade negatively, whereas the SMUS shock positively.

Hence, bullish markets in Switzerland and the US would have different impacts on the carry trade activity. Nevertheless, data show that both markets are experiencing a long-term upward trend in the NI period. Presumably, results could be demonstrating the channelling of financial investments to foreign markets instead of the domestic stock market. In this sense, the innovative policies of the SNB may be creating more incentives for speculative operations in the financial market rather than to productive investments in the Swiss economy. This is consistent with the adverse side effects of NI policy emphasised by some authors (for example, Rossi 2019).

As for the results of the VIX shock on carry trade during the NI period, they are enclosed by zero (not significant). In the following, we analyse the impacts of the franc carry trade activity on the financial variables with Fig. 4 and Fig. 5. Given the low contributions found in the forecast-error variance analysis, the results need a careful interpretation.

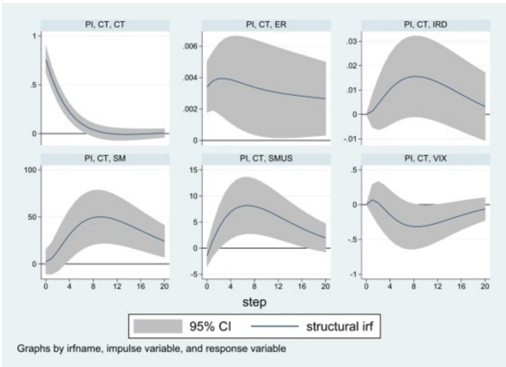


Figure 4: Structural Impulse Responses to the NP shock, PI period

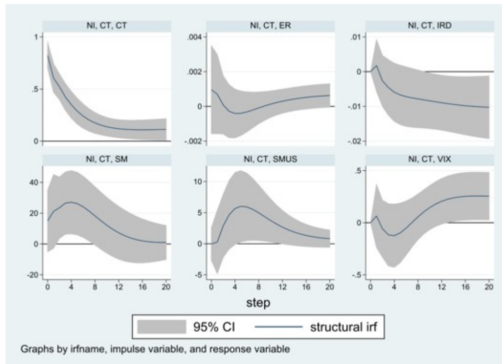


Figure 5: Structural Impulse Responses to the NP shock, NI period

In the period of positive interest rates, Fig. 4 shows three significant impacts by the carry trade. Firstly, an initial CT shock increases the ER up to five weeks ahead. A similar result is found in Nishigaki (2007). Likewise, in a sort of self-fulfilling manner, carry traders reinforce their gains with the depreciation of the CHF. Secondly, respectively, from two weeks up to 16 and from four weeks onwards after the initial shock, SMUS and SM increase with a positive shock in CT. The dynamic relationship of ER, SM, and SMUS with carry trade represents well the Swiss franc being a target currency in the PI period.

As for the NI period is concerned, Fig. 5 displays the results. In the case of ER, there is not enough statistical evidence to interpret the results. Inversely to the effect in the period of positive interest rates, carry trade and interest rate differentials have an inverse relationship. After ten weeks, the negative impact of CT on IRD becomes statistically significant. More strikingly, it is the positive impact of carry trade shocks on SM, SMUS, and VIX. Nevertheless, there are only significant results for a short period ahead of the initial shock: 3 to 8 weeks for SM, 5 to 12 for SMUS, and 13 to 20 for VIX. Crucially, the unwind of the Swiss franc carry trade activity would have negative impacts not only on the domestic market but also on foreign markets.

Also, as the robustness of the results is concerned, Fig. A1 (Appendix) shows that both estimated models respect the stability condition (all eigenvalues lie inside the unit circle).

5. Main conclusions and policy implications

In a rather innovative approach, this article investigates the Swiss carry trade with data from real positions by speculators in the US futures market. Additionally, we explore two different periods of policy interest rates in Switzerland. Notably, we add new empirical results to the period of negative interest rates.

Overall, we address two questions in this paper: (1) what the impacts of the financial variables on the carry trade are, and (2) what the impact of the carry trade on the financial variables is. As the results of the first question are concerned, we found impressive results in the effects of the IRD on the carry trade. First of all, the contribution of IRD is more substantial in both short and long-term in the NI period than in the PI period. Additionally, an initial positive shock on IRD has a positive impact on the short-run and a negative in the long-run. Therefore, the role of safe haven currency may be reinforced soon with the current downward movement of the US policy rate. Moreover, the Swiss franc may still hold its funding currency characteristic to other currencies with positive policy interest rates.

Concerning our second question, we found relatively weak evidence of the impact of the carry trade on the financial variables. Most importantly, according to the variance decompositions for the NI period, the unwind of the carry trade would impact the market sentiment negatively in the long-run and both Swiss and US stock markets. Moreover, there is evidence of systemic risk in the period of negative rates. Nonetheless, results need to be interpreted with caution because the contributions in the forecast error are relatively small.

Be that as it may, our findings are consistent with the existing literature stressing the negative impact of carry trade activities on global financial and monetary risk. Specifically, carry trade activities participate in exerting a negative impact on monetary policies in the sense they increase exchange rate volatility and then reduce predictability on exchange rate movements. As far as the SNB is concerned, it is alleged that carry trade activities may have played a role in the recent appreciation of the Swiss franc (Gubler 2014).

Although such an appreciation is not a problem for Switzerland in the long run, it could be nevertheless harmful in the short term when some thresholds are crossed, as the recent crisis has demonstrated. Since it would be undoubtedly complicated for the SNB to set-up an official floor against the euro once again, it could be useful for the SNB to announce exchange rate targets against the USD and the EUR (through crawling pegs), being these targets designed with the help of the Fed and the ECB. Likewise, this could be very useful to manage carry trade activities, since exchange rate evolution seems to have predictive power for carry trade activities (Gubler 2014).

However, symmetrically, it should be not forgotten that central banks' monetary policies too are likely to influence carry trade activities when these monetary policies are not coordinated in particular. The SNB's actual negative interest rates policy may have created incentives for more speculative operations on the Swiss financial market (Rossi, 2019). This finding supports the idea of the strengthening of the SNB's missions towards the supervision of asset prices in Switzerland. Specifically, this means that the SNB should reinforce its macro-prudential supervision through the building of new instruments aiming to take into account the evolution of financial variables into its monetary reaction function, through new types of monetary and financial condition indexes for instance (Guillaumin and Vallet 2017).

References

Adrangi, Bahram, and Arjun Chatruth. 1998. "Futures Commitments and Exchange Rate Volatility." *Journal of Business Finance & Accounting* 25 (3): 501–20. https://doi.org/10.1111/1468-5957.00200.

Amiri, Arshia, and Bruno Ventelou. 2012. "Granger Causality Between Total Expenditure on Health and GDP in OECD: Evidence from the Toda–Yamamoto Approach." *Economics Letters* 116 (3): 541–44. https://doi.org/10.1016/j.econlet.2012.04.040.

Bank for International Settlements. 2015. *Currency Carry Trades in Latin America*. BIS Papers 81. Bank for International Settlements. https://ideas.repec.org/b/bis/bisbps/81.html.

Brunnermeier, Markus K., Stefan Nagel, and Lasse H. Pedersen. 2008. "Carry Trades and Currency Crashes." *NBER Macroeconomics Annual* 23 (January): 313–48. https://doi.org/10.1086/593088.

Burnside, Craig, Martin Eichenbaum, and Sergio Rebelo. 2007. "The Returns to Currency Speculation in Emerging Markets." *American Economic Review* 97 (2): 333–38. https://doi.org/10.1257/aer.97.2.333.

Cenedese, Gino, Lucio Sarno, and Ilias Tsiakas. 2014. "Foreign Exchange Risk and the Predictability of Carry Trade Returns." *Journal of Banking & Finance* 42 (May): 302–13. https://doi.org/10.1016/j.jbankfin.2014.01.040.

Chalupa, Karel V. 1982. "Foreign Currency Futures: Reducing Foreign Exchange Risk." *Economic Perspectives*, 3–11. https://econpapers.repec.org/article/fipfedhep/y_3a1982_3ai_3awin_3ap_3a3-11_3an_3av.6no.3.htm.

Chang, Eric C., J. Michael Pinegar, and Barry Schachter. 1997. "Interday Variations in Volume, Variance and Participation of Large Speculators." *Journal of Banking & Finance* 21 (6): 797–810. https://doi.org/10.1016/S0378-4266(97)00007-1.

Chen, Hao, Hua Liao, Bao-Jun Tang, and Yi-Ming Wei. 2016. "Impacts of OPEC's Political Risk on the International Crude Oil Prices: An Empirical Analysis Based on the SVAR Models." *Energy Economics* 57 (June): 42–49. https://doi.org/10.1016/j.eneco.2016.04.018.

Clarida, Richard, Josh Davis, and Niels Pedersen. 2009. "Currency Carry Trade Regimes: Beyond the Fama Regression." *Journal of International Money and Finance*, The global financial crisis: Causes, threats and opportunities, 28 (8): 1375–89. https://doi.org/10.1016/j.jimonfin.2009.08.010.

Clemente, Jesús, Antonio Montañés, and Marcelo Reyes. 1998. "Testing for a Unit Root in Variables with a Double Change in the Mean." *Economics Letters* 59 (2): 175–82. https://doi.org/10.1016/S0165-1765(98)00052-4.

Commission, Commodity Futures Trading. 2020. "Explanatory Notes." 2020. https://www.cftc.gov/MarketReports/CommitmentsofTraders/index.htm.

Curcuru, Stephanie, Clara Vega, and Jasper Hoek. 2011. "Measuring Carry Trade Activity." In *IFC Bulletins Chapters*, 34:436–53. Bank for International Settlements. https://ideas.repec.org/h/bis/bisifc/34-31.html.

Darvas, Zsolt. 2009. "Leveraged Carry Trade Portfolios." *Journal of Banking & Finance* 33 (5): 944–57. https://doi.org/10.1016/j.jbankfin.2008.10.007.

Dodd, Randall, and Stephany Griffith-Jones. 2007. “Brazil’s Derivatives Markets: Hedging, Central Bank Intervention and Regulation.” Series Históricas 20. Naciones Unidas Comisión Económica para América Latina y el Caribe (CEPAL).

Doskov, Nikolay, and Laurens Swinkels. 2015. “Empirical Evidence on the Currency Carry Trade, 1900–2012.” *Journal of International Money and Finance* 51 (March): 370–89. https://doi.org/10.1016/j.jimonfin.2014.12.001.

Farhi, Emmanuel, and Xavier Gabaix. 2016. “Rare Disasters and Exchange Rates.” *The Quarterly Journal of Economics* 131 (1): 1–52. https://doi.org/10.1093/qje/qjv040.

Fritz, Barbara, and Daniela Prates. 2014. “The New IMF Approach to Capital Account Management and Its Blind Spots: Lessons from Brazil and South Korea.” *International Review of Applied Economics* 28 (2): 210–39. https://doi.org/10.1080/02692171.2013.858668.

Galati, Gabriele, Alexandra Heath, and Patrick McGuire. 2007. “Evidence of Carry Trade Activity.” *BIS Quarterly Review*.

Goda, Thomas, and Jan Priewe. 2019. “Determinants of Real Exchange Rate Movements in 15 Emerging Market Economies.” IPE Working Papers 128/2019. Berlin School of Economics; Law, Institute for International Political Economy (IPE).

Goldstein, Henry N. 1983. “Foreign Currency Futures: Some Further Aspects.” *Economic Perspectives*, no. nov: 3–13. https://econpapers.repec.org/article/fipfedhep/y_3a1983_3ai_3anov_3ap_3a3-13_3an_3av.7no.6.htm.

Gubler, Matthias. 2014. “Carry Trade Activities: A Multivariate Threshold Model Analysis.” Working Paper 2014-06. Swiss National Bank.

Hameed, Allaudeen, and Andrew K. Rose. 2018. “Exchange Rate Behaviour with Negative Interest Rates: Some Early Negative Observations.” *Pacific Economic Review* 23 (1): 27–42. https://doi.org/10.1111/1468-0106.12250.

Houthakker, H. S. 1957. “Can Speculators Forecast Prices?” *The Review of Economics and Statistics* 39 (2): 143–51. https://doi.org/10.2307/1928531.

Jochum, Christian, and Marcel R. Savioz. 2005. “A Strange Animal? The Swiss Franc Exchange Rate as a &Quot;Captured" Random Walk.” *Swiss Journal of Economics and Statistics (SJES)* 141 (IV): 527–53.

Jordan, Thomas. 2016. “Monetary Policy Using Negative Interest Rates: A Status Report.” Speech. https://www.snb.ch/en/mmr/speeches/id/ref_20161024_tjn/source/ref_20161024_tjn.en.pdf.

Kang, Wenjin, K. Geert Rouwenhorst, and Ke Tang. 2020. “A Tale of Two Premiums: The Role of Hedgers and Speculators in Commodity Futures Markets.” *The Journal of Finance* 75 (1): 377–417. https://doi.org/10.1111/jofi.12845.

Kay, Benjamin S. 2018. “Implications of Central Banks’ Negative Policy Rates on Financial Stability.” *Journal of Financial Economic Policy* 10 (2): 310–20. https://doi.org/10.1108/JFEP-10-2017-0096.

Klitgaard, Thomas, and Laura Weir. 2004. “Exchange Rate Changes and Net Positions of Speculators in the Futures Market.” *Economic Policy Review*, 17–28. https://ideas.repec.org/a/fip/fednep/y2004imayp17-28nv.10no.1.html.

Kugler, Peter, and Beatrice Weder. 2002. "The Puzzle of the Swiss Interest Rate Island: Stylized Facts and a New Interpretation." *Aussenwirtschaft* 57 (1): 49–64. https://ideas.repec.org/a/usg/auswrt/2002570149-64.html.

Menkhoff, Lukas, Lucio Sarno, Maik Schmeling, and Andreas Schrimpf. 2012. "Carry Trades and Global Foreign Exchange Volatility." *The Journal of Finance* 67 (2): 681–718. https://doi.org/10.1111/j.1540-6261.2012.01728.x.

Mogford, Caroline, and Darren Pain. 2006. "The Information Content of Aggregate Data on Financial Futures Positions." *Bank of England Quarterly Bulletin*, 9.

Mulligan, Nicholas, and Daan Steenkamp. 2018. "Reassessing the Information Content of the Commitments of Traders Positioning Data for Exchange Rate Changes." AN2018/03. Reserve Bank of New Zealand.

Prates, Daniela Magalhães, and Luiz Fernando De Paula. 2017. "Capital Account Regulation in Brazil: An Assessment of the 2009-2013 Period." *Brazilian Journal of Political Economy* 37 (1): 108–29. https://doi.org/10.1590/0101-31572016v37n01a06.

Ranaldo, Angelo, and Paul Söderlind. 2010. "Safe Haven Currencies." *Review of Finance* 14 (3): 385–407. https://doi.org/10.1093/rof/rfq007.

Rossi, Sergio. 2019. "The Dangerous Ineffectiveness of Negative Interest Rates: The Case of Switzerland." *Review of Keynesian Economics* 7 (2): 220–32. https://doi.org/10.4337/roke.2019.02.07.

Spronk, Richard, Willem F. C. Verschoor, and Remco C. J. Zwinkels. 2013. "Carry Trade and Foreign Exchange Rate Puzzles." *European Economic Review* 60 (May): 17–31. https://doi.org/10.1016/j.euroecorev.2013.01.007.

Toda, Hiro Y., and Taku Yamamoto. 1995. "Statistical Inference in Vector Autoregressions with Possibly Integrated Processes." *Journal of Econometrics* 66 (1): 225–50. https://doi.org/10.1016/0304-4076(94)01616-8.

Appendix

Table A1: Descriptive statistics

	PI period						NI period					
Variable	CT	ER	IRD	VIX	SM	SMUS	CT	ER	IRD	VIX	SM	SMUS
Observations	377	377	377	377	377	377	256	256	256	256	256	256
Mean	1.60	0.99	0.09	22.39	6,896.30	1,363.29	2.39	0.98	-1.81	15.27	8,870.29	2,431.12
Std. Deviation	1.48	0.10	0.46	10.19	1,093.98	314.88	1.87	0.02	0.82	4.27	587.36	343.91
Min.	0.09	0.74	-2.00	10.99	4,358.00	696.33	0.22	0.87	-3.13	9.43	7,583.27	1,852.21
Max.	9.69	1.22	1.50	67.64	9,138.56	2,067.03	10.62	1.03	-0.38	36.02	10,314.16	3,091.84

Table A2: Clemente-Montañés-Reyes unit-root tests, Innovative Outlier Model

	PI period						NI period					
Variable	CT	ER	IRD	VIX	SM	SMUS	CT	ER	IRD	VIX	SM	SMUS
(rho-1)	-0.12	-0.07	-0.10	-0.07	-0.04	-0.02	-0.25	-0.18	-0.03	-0.17	-0.07	-0.02
t-stat	-3.92	-4.54	-7.86	-4.10	-3.94	-2.34	-4.94	-4.16	-3.03	-4.60	-2.74	-1.75
Critical value (5%)	-4.19	-4.19	-4.19	-4.19	-4.19	-4.19	-4.19	-4.19	-4.19	-4.19	-4.19	-4.19
I(d)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(0)	I(1)	I(1)
T	339	339	339	339	339	339	230	230	230	230	230	230

Note: Critical values are taken from Table 4 (T = 8) in Perron and Vogelsang (1992).

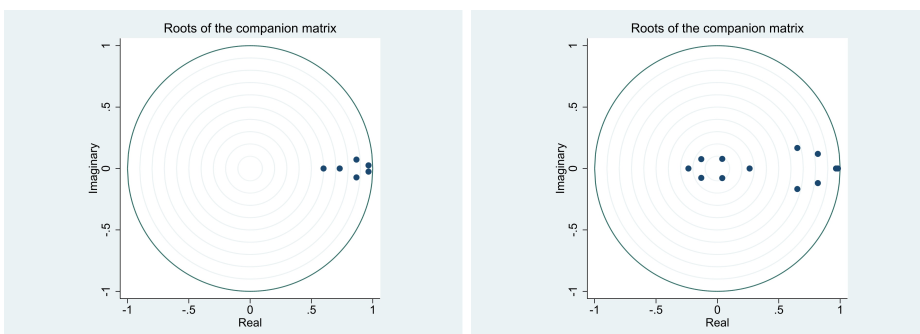
Table A3: Optimal lag-order

	PI period				NI period			
Lags	LR	AIC	HQIC	SBIC	LR.1	AIC.1	HQIC.1	SBIC.1
0	-	19.06	19.06	19.06	-	16.64	16.64	16.64
1	5,648.82	3.78	3.93*	4.17*	3,520.99	3.17*	3.37*	3.67*
2	102.46	3.7	4	4.47	51.00*	3.25	3.65	4.25
3	112.05	3.59	4.05	4.74	36.43	3.39	3.99	4.89
4	122.02	3.45	4.06	4.99	23.17	3.58	4.38	5.58
5	73.89	3.45	4.21	5.37	48.64	3.67	4.68	6.17
6	93.32	3.39*	4.3	5.69	37.45	3.81	5.01	6.8
7	50.1	3.45	4.52	6.14	43.43	3.92	5.32	7.41
8	77.84	3.43	4.65	6.51	37.77	4.05	5.66	8.04
9	86.72	3.39	4.77	6.85	49.19	4.14	5.95	8.63
10	72.78	3.39	4.92	7.24	44.75	4.25	6.26	9.24
11	63.68	3.41	5.09	7.64	39.35	4.38	6.58	9.86
12	60.64*	3.44	5.28	8.06	46.21	4.48	6.88	10.46

Note: The preferred value is marked with an asterisk (*).

Table A4: Lagrange-multiplier (LM) test for residual autocorrelation (p-values)

Lags	PI	NI
1	0.16	0.00
2	0.45	0.73
3	0.00	0.00
4	0.16	0.07
5	0.29	0.00
6	0.00	0.38
7	0.02	0.31
8	0.05	0.07
9	0.01	0.12
10	0.20	0.06
11	0.17	0.01
12	0.73	0.73



(a) PI

(b) NI

Figure A1: Eigenvalue stability condition

Table A5: Exogenous variables for each model

Sample	VAR lag length (p)	Exogenous variables
PI	1	CT_{t-2}, VIX_{t-2}, SM_{t-2}, $SMUS_{t-2}$
NI	2	$QE2$, ER_{t-3}, IRD_{t-3}, SM_{t-3}, $SMUS_{t-3}$