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Deviations from covered interest rate parity and capital outflows: The case of Switzerland

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Abstract

We investigate the relationship between deviations from the covered interest rate parity (CIP) and Swiss capital outflows since the great financial crisis. While the CIP held tightly before the crisis, it has been failing for most currencies vis-à-vis the US dollar ever since. We expect CIP deviations to adversely affect outflows, as they generally result in additional costs for Swiss investors. We find empirical support for our hypothesis. Our results show that with increasing CIP deviations, Swiss portfolio investment debt outflows decrease significantly. This decrease could have implications for the demand for domestic currency investments.

Keywords: covered interest rate parity, cross-currency basis, dollar funding, capital flows, portfolio investments

JEL classification codes: F31, F32, G11, G15

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1. Introduction

The covered interest rate parity (CIP) condition, almost considered a physical law in international finance, states that the interest rates of two otherwise identical assets in two different currencies should be equal once the foreign currency risk is hedged. However, since the great financial crisis, the CIP has failed to hold for all major currencies vis-à-vis the US dollar. Whenever the CIP fails, one party has to pay a premium in addition to the cash market rates to borrow the corresponding currency, while the counterparty receives an equivalent discount when borrowing the other currency.

Initially, deviations from the CIP condition were seen as a temporary market failure, which should gradually disappear as financial markets return to normal (Baba and Packer, 2009; Coffey et al., 2009; Genberg et al., 2011; Mancini-Griffoli and Ranaldo, 2011). However, the deviations have persisted in the wake of the global recovery. More recently, researchers have thus shifted their attention to other explanations. Some studies invoke the capital constraints of CIP arbitrageurs in the face of foreign exchange (FX) swap funding demand from banks (Iida et al., 2016), from foreign currency bond issuers (Liao, 2016) or from broader saving and investment imbalances (Du et al., 2018). Others attribute the persistent CIP deviations to a systemic risk factor linked to the role of the US dollar as the global funding currency (Shin, 2016) or to market segmentation and funding liquidity premia (Rime et al., 2017). Identifying the reasons for the CIP deviations is an important policy question. Equally important, however, is investigating the consequences of those CIP deviations.

In this paper, we analyse the consequence of CIP deviations for portfolio investment (PI) debt outflows from Switzerland since 2007. Specifically, we analyse whether the observed CIP deviations may explain the observed reductions in Swiss PI debt outflows. We thus investigate whether CIP deviations may be an additional determinant of capital flow movements. From a policy perspective, monitoring capital flows is essential, as these could point to emerging risks. While international capital mobility can foster growth and allows for a better sharing of macroeconomic risk, capital flows may also be fraught with risks, given the frictions that characterize financial markets (Barkbu and Ong, 2010; Koepke, 2019).

In FX markets, the CIP deviation is measured as the cross-currency swap basis. The basis indicates the amount by which the interest paid to borrow one currency by swapping it against another differs from the cost of directly borrowing this currency in the cash market. A non-zero basis indicates a violation of the CIP condition. By market convention, the basis is quoted on the non-dollar leg. Given this convention, the basis typically takes a negative sign – the USD lender pays a lower interest rate – suggesting a premium for USD borrowing. This negative basis could have implications for capital flows to and from Switzerland. The reason is that Swiss investors, who use FX derivatives to hedge the exchange rate risk of their USD-denominated assets, will have to pay more than the rate implied by the CIP condition. We investigate whether Swiss investors adjust their behaviour in response to these additional costs.

We find empirical evidence that a widening of the cross-currency swap basis, i.e. the USD/CHF basis becoming more negative, adversely affects PI debt outflows. While controlling for possible confounding factors, we find a widening of the basis to be significantly associated with a decrease in PI debt outflows. In terms of magnitude, a one-standard deviation increase in the USD/CHF basis is associated with between a 0.27 to 0.38 standard deviation decrease in USD-denominated PI debt outflows. In USD terms, PI debt outflows decrease by between 0.087 and 0.14 USD billion. With a widening basis, Swiss investors thus reduce their investments in USD debt securities.

Our results hold when we tackle potential endogeneity using instrumental variables estimations. Furthermore, we find the effect of the basis to be mediated by movements in the exchange rate. With an appreciating USD, the returns on USD investments increase. These increasing returns appear to counteract the additional costs from the widening of the basis. Last, we also study the impact of the EUR/CHF basis on EUR investments. Unlike the USD/CHF basis, the EUR/CHF basis is on average positive over the observation period. A positive basis implies that Swiss investors have to pay less than the rate implied by the CIP condition. We find a positive basis to be linked to higher PI debt outflows in EUR. However, in terms of magnitude, these flows are dwarfed by USD flows, which comprise between 70% and 90% of all PI debt outflows from Switzerland.

Upon decreasing their USD investments due to the negative basis, Swiss investors may turn to domestic currency investments, pushing their yields deeper into negative territory. Moreover, they may shift their portfolio composition and decide to decrease their hedge ratio. Such a reaction could lead to financial stability risk, which policymakers may need to address. To the extent that investors decide to buy foreign securities unhedged, CIP deviations could also have implications for Swiss franc demand.

The remainder of this paper is organized as follows. Section 2 defines the CIP condition, briefly reviews its use in financial derivatives, and discusses the capital flow measures used in the analysis. Section 3 lays out the empirical model and Section 4 introduces the data. Sections 5 and 6 present the results and robustness checks. Section 7 concludes.

2. Conceptual background: CIP and capital flows

2.1. CIP and its use in FX markets

The CIP condition is considered almost a physical law in international finance. The CIP condition states that the following relationship must hold:

$$\frac{F_{t,t+1}}{S_t} = \frac{1 + i_{t,t+1}}{1 + i^*_{t,t+1}}$$

where S_t is the spot exchange rate in US dollar units per foreign currency, $F_{t,t+1}$ is the corresponding forward exchange rate, $i_{t,t+1}$ is the USD interest rate, and $i^*_{t,t+1}$ is the foreign currency interest rate.

For example, investors with USD at hand today may deposit dollars for one month, earning the dollar deposit rate. Alternatively, they may exchange dollars for Swiss francs, deposit them and earn the Swiss deposit rate for one month. They may also enter into a one-month forward contract today, which would convert the Swiss francs earned at the end of the month into dollars. If both USD and CHF deposit rates are default-free and the forward contract has no counter-party risk, the two investment strategies are equivalent and should deliver the same payoffs.

In practice, the relationship between $F_{t,t+1}$ and S_t is read off market transactions by FX instruments. The most commonly used FX instruments for swapping cash flow streams are FX swaps for short-term transactions and cross-currency swaps for longer-term transactions. These instruments are similar, as they aid in hedging FX risk and offer investors a mechanism whereby foreign exchange can be obtained without exposure to exchange rate risk. Aside from the time component, they differ in that a cross-currency swap exchanges a series of cash flows (interest payments and principles), whereas an FX swap involves two transactions only; sell or purchase at the spot rate and repurchase or resell at the forward rate.[1] If the CIP condition holds, hedging costs are thus equal to the difference between short-term rates in the domestic and foreign currency.

If the CIP condition does not hold, the party borrowing USD via an FX instrument will pay more than in the USD cash market (Borio et al., 2017). Empirically, deviations from the CIP condition are measured by the basis. More specifically, for FX swaps, the basis is derived as the difference between the swap-implied USD rate, $\frac{F_{t,t+1}}{S_t} = \left(1 + i^*_{t,t+1}\right)$, and the actual USD Libor cost, $1 + i_{t,t+1}$.

By market convention, the basis is quoted on the non-dollar leg and thus typically takes a negative sign. For example, if a 2-year CHF/USD cross currency basis swap is quoted at -65 basis points (bp), the borrower of CHF funds will pay (*CHF Libor -65bp*) every three months in exchange for receiving *USD Libor* flat from its USD loan. Because the basis is quoted on the non-dollar leg, paying the basis means borrowing CHF and lending USD, while receiving the basis means lending the non-USD currency and borrowing in USD. Hedging costs thus change according to the amount of the basis. Whenever CIP fails, one party has to pay the basis on top of the cash market rates to borrow the corresponding currency, while the counterparty receives an equivalent discount when borrowing the other currency.

2.2. Swiss capital outflows

Our analysis focuses on portfolio investment, whereby, in contrast to direct investment, the focus is on earning income rather than exerting influence on the business activities of a company. Decisions to buy or sell are thus strongly driven by developments in financial markets, such as changes in the basis.

Transactions in portfolio investment comprise cross-border purchases and sales of equity (i.e. shares and collective investment schemes) and debt securities (i.e. bonds and money market instruments). Our data allows us to separate portfolio equity from portfolio debt securities flows. We focus on portfolio debt securities flows since these types of flows are most likely affected by hedging costs. Hedge ratios for investment in foreign currency bonds range from 50% to 100%, while they range from 20% to 60% only for equities (Borio et al., 2017).

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[1] Appendix A provides a detailed description of FX and cross-currency swaps characteristics.

Moreover, previous studies find that full hedging is the optimal strategy for bond portfolios (Schmittmann, 2010). In contrast, for equity investments, the case for hedging is more complex because the co-variances of equities and currencies contribute strongly to overall foreign investment risk (Schmittmann, 2010). More specifically, exchange rate risk contributes up to 40% to the overall risk of single-country foreign equity investments and up to 95% to the overall risk of single-country foreign bond investments.

Since the focal point of the analysis is the question of how Swiss investors react to a widening basis, we focus on PI debt *outflows*. PI debt outflows are defined as the difference between newly purchased and newly sold foreign securities, i.e. they comprise the net acquisitions of non-resident financial assets by residents. Negative values of PI debt outflows indicate a decrease in the stock of existing foreign debt instruments, while positive values indicate an increase in this stock. Furthermore, given that more than 90% of FX and cross-currency swaps involve USD (Borio et al., 2017), our analysis concentrates on USD-denominated PI debt outflows. In a robustness check, we also investigate EUR-denominated PI debt outflows.

Our analysis follows the recent capital flows literature (see, e.g. Broner et al. (2013) and Cerutti et al. (2019)) that emphasizes the importance of analysing gross flows. Most earlier studies focus on net capital flows, i.e. the difference between purchases of domestic assets by foreigners and purchases of foreign assets by domestic agents. However, domestic and foreign investors are likely to behave quite differently. For example, a reduction in net capital inflows during crises may be primarily driven by a reduction in the purchases of domestic assets by foreigners (a sudden stop) or by an increase in the purchases of foreign assets by domestic agents (capital flights). This distinction can help determine the nature of crises and thus the appropriate policy responses.

2.3. Main parties concerned by CIP deviations

Swiss investors may rely on cross-currency and FX swaps to fund their investments in USD assets without being exposed to FX risk. In the swap agreement, they change their CHF to USD to buy USD-denominated bonds. At maturity, they sell their USD-denominated bonds and swap the resulting USD back into CHF. In this way, they fully hedge the exchange rate risk. However, because of the CIP deviation, they will have to bear additional costs to enter into such a swap.

The described hedging strategy concerns primarily institutional investors, such as insurance and pension funds, which have a funding base in local currency and try to earn additional yield by investing in higher-yielding foreign securities, typically US treasury bonds (Borio et al., 2018).[2]

Moreover, they increasingly attempt to extend the duration of their assets to match the rising duration of their liabilities (Domanski et al., 2017). To reduce the duration mismatch, they swap out of their domestic currency to fund their investment in foreign assets using swap agreements. They can expect to earn a payoff equal to the difference between the foreign bond yield and their funding cost, adjusted for the gain or loss on the bond price and, most importantly for the purpose of our paper, the hedging cost.

Empirical evidence on institutional investor holdings is scarce. Since the swap agreements are off-balance sheet transactions, they are not observable. For a few countries where evidence exists, notably Germany, Japan, and Sweden, it appears that some institutional investors have increased their holdings of foreign bonds over the last few years (Shin, 2016).

3. Empirical investigation

3.1. Baseline regression

Our empirical analysis explores the relationship between the USD/CHF basis and PI debt outflows denominated in USD. We employ a standard empirical model that is often used to analyse the determinants of capital flows (Ahmed and Zlate, 2014; Nier et al., 2014; Bems et al., 2016; Koepke, 2019), augmented with our main variable of interest, the basis. The estimation equation is defined as follows:

$$y_t = \beta_0 + \beta_1 basis_t + \beta_2 \Delta EER_t + \beta_3 y_{t-1}^{Stock} + \beta_4 t + \gamma \boldsymbol{X}_t + \varepsilon_t \qquad (1)$$

where y_t is the dependent variable, PI debt outflows in USD. Our main explanatory variable is $basis_t$, notably the 3-month, 1-year and 2-year USD/CHF cross-currency basis in three separate

[2] Other market participants are also concerned by CIP deviations: banks rely on cross-currency and FX swaps to hedge the currency mismatches in their balance sheets. Non-financial firms tend to issue debt in foreign currency to take advantage of compressed spreads and credit ratings in countries implementing an unconventional monetary policy, as with the so-called reverse Yankee bonds. However, examining the impact of the CIP deviations on these types of flows is beyond the scope of this paper.

specifications. When the basis widens, i.e. becomes more negative, Swiss investors incur additional costs to hedge their foreign securities through swap agreements. The opposite is true if the basis narrows, i.e. becomes less negative.

As a control variable, we include the change in the USD effective exchange rate (EER), ΔEER_t. When the EER appreciates (ΔEER_t is positive), investment in USD-denominated securities becomes more profitable in terms of domestic currency. It should thus be positively related to USD outflows. We also include the lagged PI debt stock in USD, y_{t-1}^{Stock}, to control for a general trend in Switzerland's foreign debt assets. Following Milesi-Ferretti and Tille (2011), the relative change in in- and outflows depends on a country's net position in debt instruments (securities, loans, deposits etc.).

The vector of additional controls, $\boldsymbol{X}_t$, includes the VIX index, the GDP growth differential between the US and Switzerland, the yield differential between US and Swiss 10-year government bonds, and the term-spread differential between the US and Switzerland (10-year over 2-year). The VIX index is included to capture global risk aversion. A higher VIX is associated with increased outflows towards US government bonds, which are considered a safe haven. A higher GDP growth differential is expected to lead to more Swiss investment in US debt securities. Similarly, higher yield and term-spread differentials are expected to lead to higher Swiss investment in US debt securities (Avdjiev et al., 2019).

Lastly, t is a linear time trend and ε_t is the standard error. We use Newey-West error corrections with two lags to overcome both autocorrelation and heteroskedasticity in the error terms (Newey and West, 1987).

3.2. Instrumental variable regression

Our empirical specification may suffer from reverse causality, which could lead to biased estimates. One may argue that higher PI debt outflows may increase hedging demand and thus influence the size of the basis. To address this potential reverse causality bias, we use instrumental variable regression.

A convincing causal analysis of the link between the basis and PI debt outflows requires an exogenous source of variation in the basis. A consistent estimate of the unbiased effect can be obtained if there is a component of the vector $\boldsymbol{X}_t$ that affects the basis, but not directly PI debt outflows. The USD/CHF bid-ask spread in FX markets may be such a variable. It is simply the difference between the price at which a dealer is willing to buy and sell a currency and captures the liquidity in the FX market. In a recent paper, Borio et al. (2018) show that the basis is strongly correlated with the bid-ask spread.

However, we expect the bid-ask spread to have no direct effect on PI debt outflows. It should not influence investment decisions, which are primarily driven by the growth, yield, and term-spread differentials. We thus assume that the instrument can be omitted from our regression equation, since the role is adequately captured by the regressors 'growth differential,' 'yield differential,' and 'term-spread differential'.

Following Borio et al. (2018), we compute the FX bid-ask spreads, $\emptyset_t$, using 3-month forward rates, F_t, and spot rates, S_t, applying the following formula:

$$\emptyset_t = \begin{cases} 0.5\left[\left(F_t^{bid} - S_t^{ask}\right) - \left(F_t^{ask} - S_t^{bid}\right)\right] if\ basis_t < 0 \\ 0.5\left[\left(F_t^{ask} - S_t^{bid}\right) - \left(F_t^{bid} - S_t^{ask}\right)\right] if\ basis_t > 0 \end{cases} \qquad (2)$$

We instrument the basis with this exogenous variable and estimate the following two-equation system with 2SLS:

$$First\ stage: \quad basis_t = \beta_0 + \beta_1 \emptyset_t + \beta_2 \Delta EER_t + \beta_3 y_{t-1}^{Stock} + \beta_4 t + \gamma \boldsymbol{X}_t + u_t \qquad (3)$$

$$Second\ stage: \quad y_t = \beta_0 + \beta_1 \widehat{basis}_t + \beta_2 \Delta EER_t + \beta_3 y_{t-1}^{Stock} + \beta_4 t + \gamma \boldsymbol{X}_t + u_t \qquad (4)$$

In the first stage, we regress the basis on the instrument and the control variables from the baseline estimation equation. In the second stage, we use the predicted value of the basis to estimate the effect of the basis on the flows. With a valid and strong instrument, we should be able to consistently estimate the basis coefficients.

4. Data

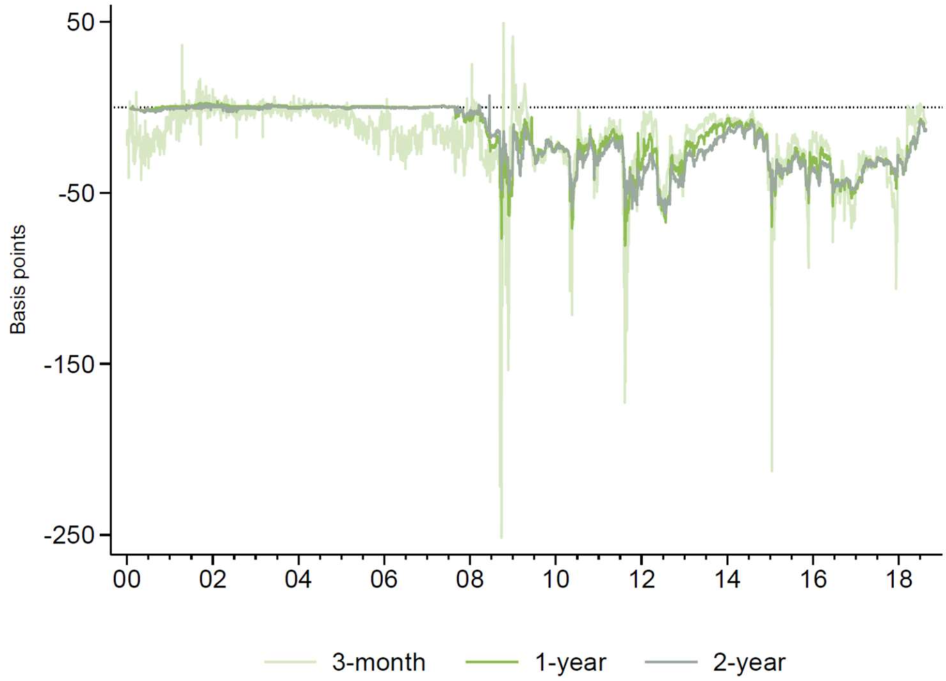
4.1. FX swap and cross-currency basis

Our main variable of interest is the CIP deviation between USD and CHF, measured in terms of the basis of FX and cross-currency swaps. For the analysis, we use the midpoint values of the basis. We investigate the basis at different maturities: the 1-year and 2-year basis are quoted in Bloomberg for the full observation period. The 3-month basis is quoted in Bloomberg only from June 2011 onwards. To obtain the data prior to that point, we compute the 3-month basis using 3-month basis Libor rates and currency forward and spot exchange rates, applying the formula of Section 2. Note that the 3-month basis for FX swaps and cross-currency swaps is identical. Furthermore, while the basis is quoted daily, capital flow data are only available on a quarterly basis. To match the frequency of our dependent and our main explanatory variables, we average the daily basis to a quarterly measure.

Figure 1 shows the USD/CHF cross-currency swap basis at the three different maturities under consideration. Prior to 2007, the basis was close to zero, meaning that the CIP condition was largely satisfied. From mid-August 2007 onwards, the basis has been negative: borrowing dollars through the FX swap market became more expensive than direct funding in the dollar cash market. The basis has widened considerably and has not returned to pre-crisis levels since, pointing towards large and persistent deviations from the CIP condition.

The described movement largely overlaps for all three maturities. The 3-month basis shows movements that are somewhat more extreme. This makes sense given that some cross-currency swap spread drivers are more significant for short maturities, while others are more significant for long maturities. Short-end spreads (i.e. FX swaps) appear to be more influenced by counterparty risk, funding liquidity, and market liquidity, while long-end swaps are more sensitive to supply and demand for assets in both currencies (Borio et al., 2016).

Figure 1: Evolution of the 3-month, 1-year and 2-year USD/CHF basis



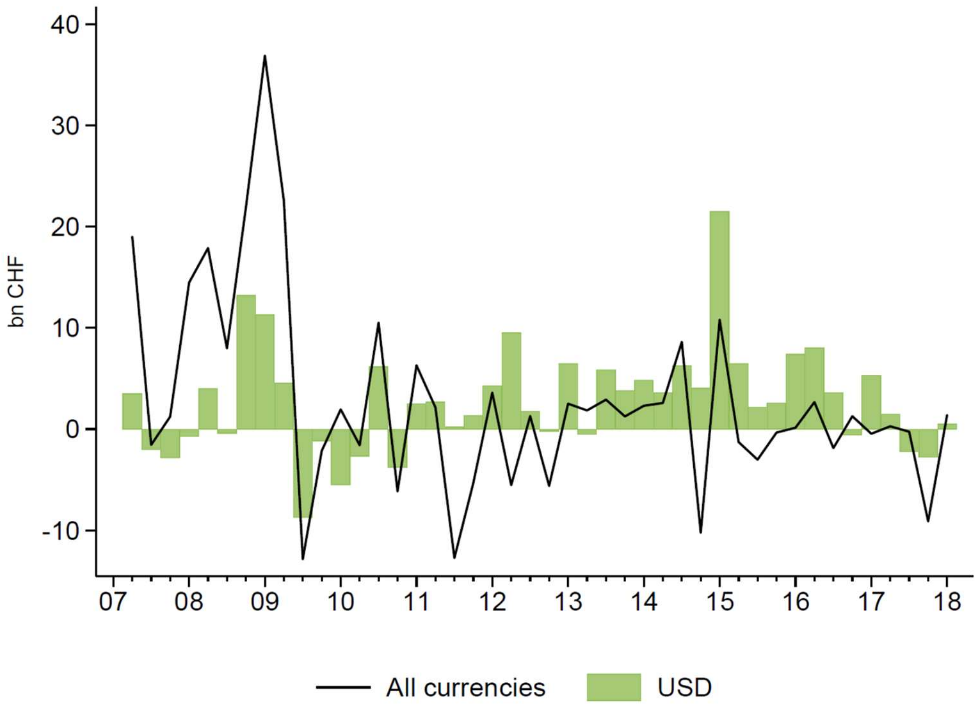
4.2. Swiss capital outflows

Our dependent variable is portfolio investment debt outflows (i.e. bonds and money market instruments) denominated in USD. We have data for total PI debt, classified according to maturities, with short-term debt including instruments with maturities less than one year, and long-term debt including instruments with maturities of more than one year. We concentrate on the long-term segment, which constitutes the overwhelming share of the total (approximately 90%) and fits more closely with the investment profile of Swiss institutional investors.

Figure 2 shows the evolution of USD-denominated PI debt outflows as well as total PI debt outflows. The clearly visible trend is the decline in PI debt outflows since the crisis, which is mostly driven by the USD (red bars). Indeed, aside from an outlier in 2009, USD flows comprise between 70% and 90% of all PI debt outflows from Switzerland.

Furthermore, we see a sharp drop in USD outflows immediately following the crisis, followed by a slow recovery from 2012 onwards. The stark spike in USD outflows in early 2015 is likely explained by the removal of the exchange rate floor and the introduction of negative interest rates by the Swiss National Bank in January 2015.

Figure 2. PI debt outflows from Switzerland, all currencies and USD



4.3. Descriptive statistics

Table 1 presents the descriptive statistics of our sample.[3] We restrict our sample period to the time since the basis has been non-zero, i.e. from 2007-Q2 until 2018-Q1. Since our data is quarterly, we have a total of 44 observations only.

Over the last decade, PI debt outflows have been quite volatile, ranging from a minimum of 8.24 USD billion to a maximum of 22.5 USD billion. Our main explanatory variable, the basis, is largely different from zero, reflecting the failure of the CIP condition. It behaves quite similarly for different maturities. On average, Swiss investors had to pay approximately 27 additional basis points to enter into a USD/CHF FX or cross-currency swap over the observation period.

Further, the USD effective exchange rate is quite volatile, moving from a depreciation of approximately 5% to an appreciation of 11% over the last decade. The VIX index shows a high global risk sentiment for our observation period with an average of 20 points. The GDP growth differential between the US and Switzerland moves between -2.7% and 2%, and the yield

[3] Appendix B provides a detailed overview of data sources.

differential between US and Swiss 10-year government bonds moves within a lower band of 0.6% and 2.7%. The movements of the term-spread differential between the US and Switzerland (10-year over 2-year) is even smaller, only moving between -0.4% and 1.5%.

Table 1: Summary statistics

	Mean	St. Dev.	Min	Max
USD PI debt outflows	2.92	5.21	-8.24	22.51
3M USD/CHF basis	-27.17	16.15	-65.88	0.56
1Y USD/CHF basis	-26.35	13.26	-51.21	0.45
2Y USD/CHF basis	-28.09	13.07	-52.74	0.29
Change in USD EER (in %)	0.10	3.42	-5.12	10.81
Lagged USD PI debt stock	148.86	50.44	89.17	238.25
VIX index	19.94	9.00	10.29	58.49
GDP growth differential (in %)	-0.14	1.23	-2.66	1.95
Yield differential (in %)	1.60	0.57	0.55	2.67
Term-spread differential (in %)	0.74	0.48	-0.36	1.50

5. Results

5.1. Baseline regression

Table 2 shows the results from our baseline regression, where we regress PI debt outflows denominated in USD on the USD/CHF cross-currency basis at three different maturities. Note that, to interpret the coefficients in the regression more intuitively, we standardize all variables to have a mean of zero and a standard deviation of one.

For all three maturities, we find a statistically significant association between the basis and USD flows. The positive sign of the coefficients should be interpreted as follows: a decrease in the basis, i.e. a more negative basis, is associated with a reduction in PI debt outflows, as this implies that Swiss investors incur higher costs when hedging against the USD. Basis and outflows move in the same direction. Conversely, an increase in the basis, i.e. a less negative basis, reflects a shrinking CIP deviation. This shrinking will reduce hedging costs and lead to increased PI debt outflows.

Regarding the magnitude of the effect, we find that a one-standard deviation more negative basis is associated with between a 0.27 to 0.38 standard deviation decrease in PI debt outflows. In USD terms, PI debt outflows decrease by between 0.087 and 0.14 USD billion.

The control variables have a mixed impact. The change in the USD effective exchange rate is statistically significant and positive, indicating that the appreciation of the USD has a positive impact on PI debt outflows. This result could be explained by the fact that Swiss investors will see the value of their USD-denominated assets increase with an appreciating dollar. Further, the lagged stock of PI debt assets is negative and statistically significant. This result is intuitive, considering the continuous fall in PI debt stock since the beginning of the financial crisis. Furthermore, the higher the PI debt stock, the more likely investors will sell and vice versa.

The coefficient of the VIX index is not statistically significant. This finding is in line with previous studies such as Milesi-Ferretti and Tille (2011) and Cerutti et al. (2019), who find that portfolio flows do not change systematically during periods of high global risk aversion. Lastly, the growth and yield differentials do not have a statistically significant impact on PI debt outflows, while the term differential is significant, but with a negative sign, which is somewhat counterintuitive.

Table 2. OLS regression of PI debt outflows in USD on the USD/CHF basis

	(1)	(2)	(3)
3M USD/CHF basis	0.266**		
	[0.12]		
1Y USD/CHF basis		0.353**	
		[0.16]	
2Y USD/CHF basis			0.377*
			[0.21]
Change in USD EER	0.548**	0.518**	0.492**
	[0.21]	[0.22]	[0.22]
L.PI debt stock assets	-1.480**	-1.532***	-1.730***
	[0.62]	[0.56]	[0.57]
VIX index	0.143	0.235	0.227
	[0.17]	[0.17]	[0.16]
GDP growth differential	0.153	0.278	0.32
	[0.25]	[0.28]	[0.31]
Yield differential	0.008	-0.059	-0.081
	[0.28]	[0.24]	[0.23]
Term differential	-0.418*	-0.423*	-0.438*
	[0.21]	[0.21]	[0.22]
Time trend	0.117**	0.133***	0.150***
	[0.05]	[0.04]	[0.05]
Constant	-2.642**	-2.994***	-3.365***
	[1.02]	[0.97]	[1.01]
Observations	44	44	44
R^2	0.437	0.444	0.443

Note: *** p < 0.01; ** p < 0.05; * p < 0.1. Newey-West standard errors with 2 lags are reported in brackets.

5.2. Instrumental variable regression

Table 3 shows the first stage results of our 2SLS regression. It has high explanatory power for the 3-month basis, with a positive and highly statistically significant coefficient. However, we find no statistically significant correlation for the 1-year and the 2-year basis. The instrument is thus not adequate for the longer-term basis. This result is sensible, since the short-term basis is influenced more by credit and liquidity premia, while the longer-term basis is driven more by supply and demand for assets and currencies.

Furthermore, most investors rely on rolling quarterly hedges, i.e. the 3-month basis, to hedge their foreign securities, which means that they will have to pay the FX bid-ask spread several time for securities with maturities longer than three months. The 3-month FX bid-ask spread thus has high explanatory power for movements in the 3-month basis.

Because we have one instrument for one endogenous variable, we cannot test instrument validity. However, the first stage tests for instrument relevance. The value of the F-statistic of the first stage is well above 10, so that we can confidently assume that our instrument is strong (Staiger et al., 1997). As an additional test for weak instruments, Stock et al. (2002) propose a test for the just-identified case. If we are willing to tolerate distortion for a 5% Wald test based on the 2SLS estimator so that the true size can be at most 10%, then we reject the null hypothesis if the test statistic exceeds 16.38. As the F-statistic exceeds this value, we feel comfortable in rejecting the null of weak instruments.

Table 4 shows the second stage results of our 2SLS regression. We find a marginally statistically significant positive effect of the 3-month basis on PI debt outflows. In contrast, the coefficients of the basis in the 1-year and 2-year specifications are not significant, which corroborates the instruments' weakness for these maturities. The results for other control variables are similar to the baseline equation.

Using the FX bid-ask spread as an exogenous determinant of the basis yields unbiased IV estimates for the 3-month basis of 0.328, slightly larger than the corresponding OLS estimates. The standard errors of the IV estimates are larger than the OLS estimates but are not overly inflated. For this short-term maturity, we can thus consistently tackle potential bias resulting from reverse causality. Because the effect size is not greatly affected by the instrument, endogeneity may not be of a great concern. Overall, the results thus support our hypothesis for the short-term basis.

Table 3. First-stage regression of the USD/CHF basis on the USD/CHF bid-ask spread

	(1)	(2)	(3)
3M FX bid-ask	0.589***		
	[0.13]		
1Y FX bid-ask		0.15	
		[0.28]	
2Y FX bid-ask			0.237
			[0.26]
Change in USD EER	-0.334**	-0.189*	-0.113
	[0.13]	[0.11]	[0.10]
L.PI debt stock assets	-0.616	-0.642	-0.039
	[0.90]	[0.71]	[0.67]
VIX index	-0.104	-0.273	-0.159
	[0.20]	[0.17]	[0.15]
GDP growth differential	0.006	-0.361**	-0.428***
	[0.16]	[0.15]	[0.14]
Yield differential	0.249	0.236	0.287
	[0.29]	[0.31]	[0.29]
Term differential	0.125	0.027	0.05
	[0.15]	[0.20]	[0.18]
Time trend	0.041	0.008	-0.033
	[0.06]	[0.05]	[0.04]
Constant	-0.924	-0.191	0.741
	[1.30]	[1.01]	[0.92]
Observations	44	44	44
R^2	0.437	0.444	0.443

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. Standard errors reported in brackets are corrected for heteroskedasticity and autocorrelation of order 2.

Table 4. Second-stage regression of PI debt outflows in USD on basis hat

	(1)	(2)	(3)
3M USD/CHF basis	0.328*		
	[0.19]		
1Y USD/CHF basis		1.227	
		[2.24]	
2Y USD/CHF basis			0.778
			[1.11]
Change in USD EER	0.570***	0.676*	0.532***
	[0.18]	[0.39]	[0.17]
L.PI debt stock assets	-1.410**	-0.92	-1.678**
	[0.67]	[2.07]	[0.71]
VIX index	0.154	0.577	0.366
	[0.16]	[0.91]	[0.44]
GDP growth differential	0.157	0.624	0.515
	[0.21]	[0.82]	[0.49]
Yield differential	0.005	-0.252	-0.186
	[0.25]	[0.66]	[0.43]
Term differential	-0.421**	-0.467**	-0.473***
	[0.19]	[0.21]	[0.17]
Time trend	0.113**	0.130**	0.166***
	[0.04]	[0.05]	[0.05]
Constant	-2.553***	-2.916**	-3.727***
	[0.97]	[1.16]	[1.17]
Observations	44	44	44
R^2	0.434	0.100	0.380

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. Standard errors reported in brackets are corrected for heteroskedasticity and autocorrelation of order 2.

6. Robustness checks

6.1. Interaction effect

The impact of the basis on PI debt outflows could be mediated by exchange rate movements. For example, when the USD appreciates, investments in USD-denominated securities are worth more in Swiss franc terms, which could compensate for the basis-related costs. Moreover, it is possible that investors may increase their unhedged investment in USD, which in turn reduces demand for hedging, resulting in more PI debt outflows. To capture this effect, we include an interaction term between the basis and the USD EER in our estimation equation. We augment the baseline equation in the following way:

$$y_t = \beta_0 + \beta_1 basis_t + \beta_2 \Delta EER_t + \beta_3 basis_t \times \Delta EER_t + \beta_4 y_{t-1}^{Stock} + \beta_5 t + \gamma \boldsymbol{X}_t + \varepsilon_t \quad (5)$$

Table 5 shows the regression results of the basis on PI debt outflows, using an interaction term between the basis and the change in the USD EER. The table shows that the coefficient of the 3-month basis increases by about two thirds, and the coefficient of the change in the USD EER shrinks by about one third when including the interaction effect. Conversely, the coefficient of the 1-year basis is hardly affected, while the coefficient of the 2-year basis loses its marginal significance from the baseline. The interaction effect itself is negative and statistically significant at the 5% level on the 3-month basis only. Taking the interaction effect between the basis and the USD EER into account significantly increases the R squared for all maturities, thus improving model fit.

To interpret the effect size, note that both the basis and the change in the USD EER are standardized to have a mean of zero and a standard deviation of one. Therefore, at the mean USD EER, we find that a one-standard deviation more negative basis is associated with a 0.4 standard-deviation decrease in PI debt outflows. At its lowest value, a depreciation in the USD EER of 1.5%, a one-standard deviation more negative basis is associated with a 0.96 standard-deviation decrease in PI debt outflows. At its highest value, an appreciation in the USD EER of 3.1%, a one-standard deviation more negative basis, is associated with a 0.77 standard-deviation increase in PI debt outflows. As previously argued, a change in the USD EER thus mediates the effect of the basis on PI flows.

Following Krogstrup and Tille (2018), this interaction effect may capture an important risk-taking channel. With an appreciating USD, the potential gains from investing in USD-denominated assets become larger and investors may become more risk-seeking, thus caring less about hedging costs, including the basis.

Table 5. OLS regression of PI debt outflows on the basis, including an interaction term

	(1)	(2)	(3)
3M USD/CHF basis	0.401***		
	[0.11]		
1Y USD/CHF basis		0.350**	
		[0.16]	
2Y USD/CHF basis			0.347
			[0.21]
Change in USD EER	0.401**	0.379**	0.434**
	[0.17]	[0.17]	[0.19]
3M basis x Δ EER	-0.374**		
	[0.17]		
1Y basis x Δ EER		-0.337	
		[0.21]	
2Y basis x Δ EER			-0.221
			[0.24]
L.PI debt stock assets	-1.433**	-1.586***	-1.757***
	[0.53]	[0.49]	[0.54]
VIX index	-0.031	0.169	0.235
	[0.21]	[0.18]	[0.16]
GDP growth differential	0.163	0.221	0.241
	[0.23]	[0.26]	[0.28]
Yield differential	-0.127	-0.199	-0.147
	[0.24]	[0.22]	[0.23]
Term differential	-0.387**	-0.333**	-0.361*
	[0.17]	[0.16]	[0.18]
Time trend	0.124**	0.158***	0.166***
	[0.05]	[0.04]	[0.05]
Constant	-2.940***	-3.671***	-3.793***
	[1.02]	[0.92]	[1.05]
Observations	44	44	44
R^2	0.529	0.491	0.458

Note: *** p < 0.01; ** p < 0.05; * p < 0.1. Standard errors reported in brackets are corrected for heteroskedasticity and autocorrelation of order 2.

6.2. EUR basis

Our data also includes PI flows denominated in EUR, which allows us to investigate whether the relationship between PI debt outflows and the basis is limited to the USD. In a further robustness check, we use our baseline model and replace all USD variables with EUR variables. We concentrate on EUR-denominated flows, since the CHF cross-currency basis is quoted only against the USD and the EUR. Figure 3 shows the evolution of the 3-month, 1-year, and 2-year EUR/CHF basis.

Overall, the EUR/CHF basis behaves similarly to the USD/CHF basis for all three maturities. However, it has been positive most of the time until mid-2012 (Brophy et al., 2019). The period from 2008 to 2012 was characterized first by the credit crunch and then by the euro-area debt crisis. The latter in particular could have played an important role in the investment decisions of Swiss residents. Indeed, PI debt outflows towards euro-denominated securities were quite consistent until mid-2009, when doubts about the fiscal positions of several euro area countries emerged.

Since 2012, the EUR/CHF basis has shrunk, reaching considerably lower absolute levels than the USD/CHF basis. One exception is a short period after the removal of the EUR/CHF floor in January 2015, where the basis sunk in negative territory. This could reflect the narrowing of yield differentials between the euro and Swiss franc bonds and the reduced volatility in the EUR/CHF exchange rate following the introduction of the floor by the SNB in September 2011.

Note that since the EUR/CHF basis is on average positive, Swiss investors should gain from investing abroad. Thus, an increase in the basis in positive territory should lead to an increase in Swiss capital outflows towards EUR-denominated securities. The direction of the effect, i.e. the sign of the coefficients, should thus be the same for both the USD/CHF and the EUR/CHF basis. Basis and flows move in the same direction.

Figure 3: Evolution of the 3-month, 1-year and 2-year EUR/CHF basis

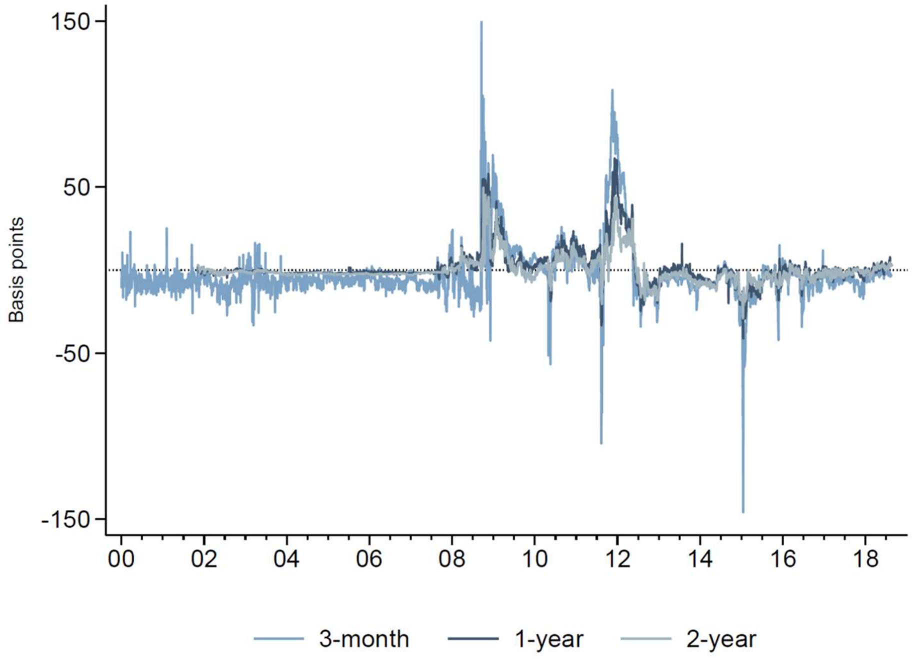


Table 6 shows the corresponding regression results. We find a marginally significant effect for the 3-month basis. For the short-term basis, we can thus confirm the mechanism identified for the USD/CHF basis. When the basis becomes more positive (negative), Swiss investors have to pay less (more) to hedge their EUR-denominated securities and they increase (decrease) PI debt outflows in EUR.

Regarding the magnitude of the effect, we find that a one-standard deviation increase in the basis is associated with a 0.24 standard deviation increase in PI debt outflows. Overall, however, the EUR specifications perform more poorly than the USD specifications. This result is in line with the literature showing that the basis is a dollar-driven phenomenon (Borio et al., 2017).

Table 6. OLS regression of PI debt outflows in EUR on the EUR/CHF basis

	(1)	(2)	(3)
3M EUR/CHF basis	0.238*		
	[0.14]		
1Y EUR/CHF basis		0.075	
		[0.20]	
2Y EUR/CHF basis			-0.007
			[0.26]
Change in EUR EER	0.104	0.134	0.141
	[0.12]	[0.12]	[0.12]
L.PI debt stock assets	-0.248*	-0.248*	-0.252*
	[0.13]	[0.13]	[0.13]
VIX index	0.087	0.201	0.258
	[0.18]	[0.24]	[0.27]
GDP growth differential	-0.005	0.025	0.03
	[0.21]	[0.21]	[0.21]
Yield differential	-0.24	-0.207	-0.172
	[0.25]	[0.28]	[0.30]
Term differential	-0.281	-0.193	-0.166
	[0.18]	[0.15]	[0.13]
Time trend	-0.015	-0.014	-0.013
	[0.03]	[0.03]	[0.03]
Constant	0.341	0.321	0.286
	[0.63]	[0.66]	[0.67]
Observations	44	44	44
R^2	0.283	0.260	0.258

Note: *** p < 0.01; ** p < 0.05; * p < 0.1. Standard errors reported in brackets are corrected for heteroskedasticity and autocorrelation of order 2.

7. Conclusion

This paper investigates whether deviations in the covered interest rate parity (CIP) may explain the reduced Swiss portfolio investment (PI) debt outflows since the great financial crisis. In an OLS framework, we regress USD-denominated PI debt outflows on the USD/CHF basis, as the common measure for the CIP deviation, alongside a comprehensive set of controls. Our results show that the widening of the USD/CHF basis is significantly negatively correlated with USD-denominated PI debt outflows.

In a robustness check, we address the potential endogeneity of our empirical framework through IV estimation. We instrument the basis with the bid-ask spread in FX markets. We expect this variable not to have a direct effect on PI debt outflows but to be significantly related to the basis. For the 3-month basis, the bid-ask spread instrument proves valid and strong. The effect size is not greatly affected by the instrumenting, indicating that endogeneity may not be of great concern. That the significant association between basis and flows is robust for the 3-month basis only makes sense, given that the short-term FX instruments are investors' preferred choice to hedge their foreign currency securities.

We also find the effect to be robust to the introduction of an interaction term between the basis and the change in USD EER. Last, we investigate the relationship between the basis and flows for an additional currency pair, namely, the EUR and CHF. Confirming earlier results, we find a significant association between the 3-month basis and PI debt outflows.

In future directions, it would be valuable to investigate whether CIP deviations also impact Swiss franc demand. Our analysis provides the first step in this regard, as we can consistently show the negative impact of the CHF/USD basis on PI debt outflows denominated in USD. However, we cannot observe whether and how Swiss investors re-compose their portfolio, i.e. whether they take on more unhedged positions in light of a widening of the basis. We would need to observe the movement of the hedge ratios, which are not available for single types of assets.

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Appendix

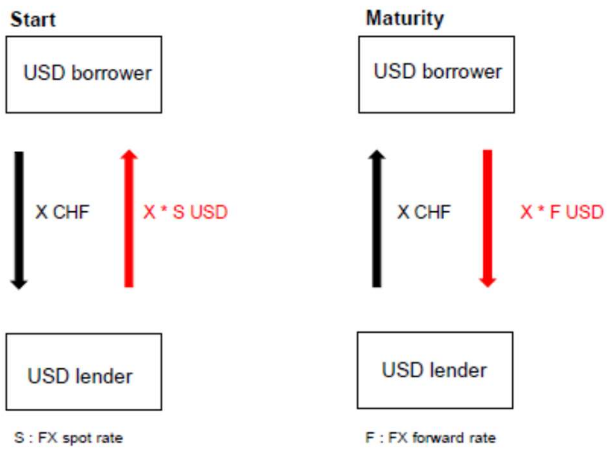
Appendix A: The mechanism of FX instruments

FX swaps

An FX swap is a contract in which one party borrows one currency from, and simultaneously lends another to, a second party. Upon initiation of the contract, domestic currency is sold for foreign currency at the spot rate, S_t. Upon termination, foreign currency is used to repurchase domestic currency. Each party uses the repayment obligation to its counterparty as collateral, and the amount of repayment is fixed at the forward rate $F_{t,t+1}$ at the start of the contract.

Figure A.1 illustrates the fund flows involved in a CHF/USD swap as an example. At the start of the contract, A borrows $X * S$ USD from, and lends X CHF to, B, where S is the FX spot rate. When the contract expires, A returns $X * F$ USD to B, and B returns X CHF to A, where F is the FX forward rate as of the start.

Figure A.1: Illustration of flows in FX swaps



Source: Baba et al. (2008).

The implicit rate of return in an FX swap is determined by the difference between $F_{t,t+1}$ and S_t, and the contract is typically quoted in forward points, $(F_{t,t+1} - S_t)$. If the party lending a currency via FX swaps makes a higher or lower return than implied by the interest rate differential between the two currencies, then the CIP fails to hold. Typically, the USD has tended to command a premium in FX swaps. In this case, rearranging the CIP equation yields the following relationship between $(F_{t,t+1} - S_t)$, $i_{t,t+1}$ and $i^*_{t,t+1}$:

$$F_{t,t+1} - S_t > S_t\left(\frac{1 + i_{t,t+1}}{1 + i^*_{t,t+1}} - 1\right)$$

A positive value of $(F_{t,t+1} - S_t)$ indicates that a party lending USD sells the foreign currency forward at a higher dollar price than warranted by the interest differential. Equivalently, a party borrowing USD via an FX swap – say, to hedge its USD asset – is effectively paying a higher interest rate on the swapped dollars than is paid in the cash market.

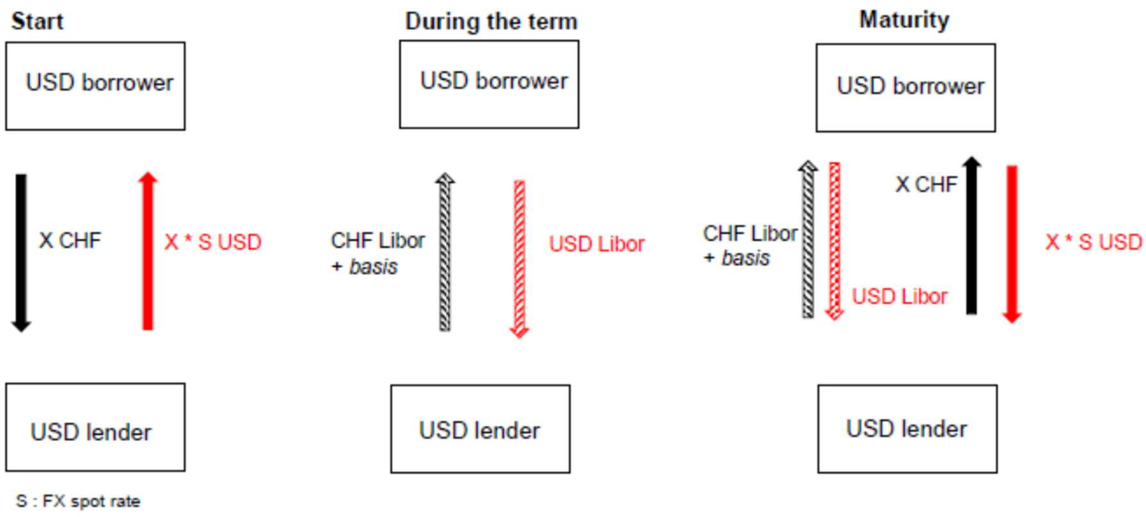
FX swaps are employed to raise foreign currencies, both for financial institutions and their customers, including exporters and importers, as well as institutional investors who wish to hedge their positions. FX swaps are most liquid at terms shorter than one year, but transactions with longer maturities have been increasing in recent years.

Cross-currency swaps

A cross-currency swap is an agreement between two parties to exchange specific amounts of different currencies. A typical cross-currency swap constitutes an agreement where two parties will exchange a series of payments in one currency for a series of payments in another currency. The payments that are exchanged are interest and principal payments of a loan denominated in one currency for a loan of an equal amount in another currency.

Figure A.2 illustrates the flow of funds involved in a CHF/USD swap. At the start of the contract, A borrows $X * S$ USD from, and lends X CHF to, B. During the contract term, A receives $(CHF\ 3M - Libor + \alpha)$ from, and pays $(USD\ 3M - Libor)$ to, B every three months, where α is the price of the basis swap, agreed upon by the counterparties at the start of the contract. When the contract expires, A returns $X * S$ USD to B, and B returns X CHF to A, where S is the same spot rate as of the start of the contract.

Figure A.2: Illustration of flows in cross-currency basis swaps



Source: Baba et al. (2008).

In a cross-currency basis swap, the reference rates are the respective Libor rates plus the basis, b. If the forward points $(F_{t,t+1} - S_t)$ are greater than warranted by CIP, then, assuming a one-period maturity, the basis b will effectively be the amount by which the interest rate on one of the legs has to be adjusted so that the parity with the pricing of FX swaps holds:

$$(F_{t,t+1} - S_t) = S_t \left(\frac{1 + i_{t,t+1} + b}{1 + i^*_{t,t+1}} \right) - S_t$$

The FX swap implied US dollar rate, $\frac{F_{t,t+1}}{S_t}(1 + i^*_{t,t+1})$, exceeds the actual USD-Libor, $(1 + i_{t,t+1})$, if the party borrowing USD in a cross-currency swap pays b on top of USD-Libor.

Thus, failure of CIP has implications for the relative cost of funding in the cash and swap markets. Whenever CIP fails, one party ends up paying the currency basis on top of the cash market rates to borrow the corresponding currency, while the other counterparty in effect receives an equivalent discount when borrowing the other currency.

Cross-currency basis swaps are employed to fund foreign currency investments, both by financial institutions and their customers, including multinational corporations engaged in foreign direct investment. They are also used as a tool for converting currencies of liabilities, particularly by issuers of bonds denominated in foreign currencies. Mirroring the tenor of the transactions they are meant to fund, most cross-currency basis swaps are long-term, generally ranging between one and 30 years of maturity.

Appendix B: Data sources

Swiss capital flows

For our measure of portfolio investment (PI) debt outflows, we use data from the balance of payments (BoP) statistic of the SNB. In the BoP, the financial account summarizes transactions between residents and non-residents in each quarter. In the financial account, PI is one of four categories. Each category has an asset (or outflows) and a liability (or inflows) side. Outflows are defined as the net acquisitions of non-resident financial assets by residents. The data are published on a quarterly basis, allowing to track the currency denomination of transactions.

Control variables

The control variables come from various sources. The US dollar real effective exchange rate (EER) is retrieved from FRED Economic Data, the VIX index from Haver Analytics, and data on the real GDP growth differential (US–Switzerland) from the OECD database. Data on the 10-year government bond yield differential (US–Switzerland) and the term-spread differential (difference between the 10-year and the 2-year constant maturity government bond yield, US–Switzerland) are retrieved from Reuters. Last, the FX bid-ask spreads are computed using Datastream and Bloomberg. All control variables are reported on a quarterly basis.

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