

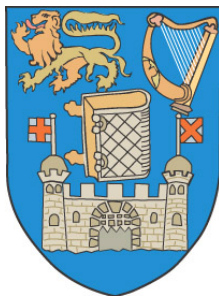
# **Cross-Currency Exposures to the Swiss Franc\***

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## **Abstract**

This paper first documents the foreign currency exposures of Switzerland in the 2002-2012 period. We find that the large scale of the Swiss international balance sheet means that movements in the Swiss Franc generate large cross-border valuation effects. Second, we examine the Swiss Franc holdings of the rest of the world and highlight differences in exposures between advanced and emerging economies.

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# 1 Introduction

This paper has two goals. First, we seek to understand the foreign currency exposures of Switzerland. In turn, following Bénétrix et al (2015), we calculate the associated currency-induced valuation effects in the Swiss net international investment position over 2002-2012. Second, from the other side, we wish to explore the Swiss Franc exposures of the rest of the world. For a 116 country sample, we quantify gross and net holdings of Swiss Francs and explore the country characteristics that correlate with the cross-country variation in Swiss Franc positions. To this end, we exploit the database on international currency exposures reported in Bénétrix et al (2015).<sup>1</sup> Estimates of international currency positions are constructed by combining a wide range of datasets in order to extract estimates for the currency of denomination of foreign assets, foreign liabilities and their main subcomponents.

We report that Switzerland has become increasingly long in foreign currencies. Moreover, we quantify the valuation impact generated by the appreciation of the Swiss Franc in recent years and find that this is large relative to GDP, given the outsized scale of the Swiss international balance sheet. The examination of the Swiss Franc positions held by other countries reveals that advanced economies exhibit a long position in Swiss Francs for the aggregate international balance sheet and a short position for debt. After the crisis, the overall long position became less positive and the debt short position became less negative. The average exposure across emerging and developing countries was a long position in the whole international balance sheet and also in the debt subcomponent. In contrast to the advanced group, these long positions became more positive after the crisis.

Our study of the determinants of cross-country exposures to the Swiss Franc produces several findings. In general, most of the action takes place in advanced economies. For these countries, exposures to other foreign currencies, international financial integration, imports, the covariance of GDP growth and currency movements, exchange rate volatility,

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<sup>1</sup>This updates the dataset originally reported in Lane and Shambaugh (2010a) which ran from 1990-2004; the new dataset runs until 2012.

capital controls and country size matter for aggregate Swiss Franc exposures. For the other samples, we also find a selection of covariates that are individually relevant: for instance, the Swiss Franc position positively covaries with inflation volatility and negatively with exchange rate pegs. However, our empirical specifications are unable to explain more than 10 percent of the overall variation in Swiss Franc exposures for these samples. By contrast, specifications focusing on Swiss Franc exposures in the debt category are more successful.

This paper relates to a growing literature on the role of the Swiss Franc in international balance sheets and international financial flows. Recent contributions include Auer (2015), Auer and Tille (2015), Habib and Stracca (2013) and Nitschka (2014) focusing on the safe haven role of securities denominated in Swiss Francs or issued in Switzerland following the outbreak of the global financial crisis. This research reports that entities outside Switzerland substantially increased assets in Swiss accounts and exposure to Swiss Franc bonds after mid-2011. In addition, it provides evidence showing that capital flows to Switzerland were heavily influenced by bank-driven flows and, to a lesser extent, Swiss residents reducing purchases of foreign debt securities. As per the currency dimension, this literature shows that Swiss securities were preferred by investors to international securities denominated in Swiss Francs. Recent papers looking at other dimensions of international capital flows from and to Switzerland include the work of Grisse and Nitschka (2015) and Yesin (2015). While the former focus on the predicted power of net foreign asset positions in forecasting exchange rate dynamics, the latter documents the significant change in capital flows volatility after the crisis. Earlier contributions to this literature include Kugler and Weder (2004, 2005, 2009).

The structure of the paper is the following. Section 2 describes the data and the approach to estimating international currency exposures. Section 3 describes Swiss currency exposures vis-à-vis all currencies for selected years and decomposes these into several sub-components. Then, valuation effects associated with these exposures are reported. Section 4 describes the cross-country exposures to the Swiss Franc and compares it with exposures

to other foreign currencies. This section also studies the determinants of exposures to the Swiss Franc in advanced and emerging/developing countries. Finally, Section 5 concludes.

## 2 International Currency Exposures

This section describes the method to estimate international currency exposures. These estimates are based on the techniques developed by Lane and Shambaugh (2010a) and Bénétrix et al (2015) that construct estimates of international foreign currency positions by drawing on a range of datasets and inferential techniques. The method follows a two-step process in which the currency composition within individual investment categories are first calculated, before obtaining aggregate exposures by weighting across categories in line with their shares in the international balance sheet.

For equity-type assets, this approach asserts that currency exposures track geographic exposures.<sup>2</sup> Information on the geographical patterns in foreign equity assets can be obtained from the IMF’s Coordinated Portfolio Investment Survey (CPIS) for portfolio equity assets, with the IMF’s Coordinated Direct Investment Survey (CDIS) and the UNCTAD bilateral FDI database providing similar data for FDI holdings. The CPIS dataset also provides the geographical pattern in portfolio debt assets, while the BIS locational banking statistics contain information on the geography of bank-type debt assets.<sup>3</sup> Since debt issuers in a given country can issue in foreign currencies as well as in domestic currency, the geographical data is combined with country-level and BIS data on the currency denomination of debt instruments to work out the currency exposures in cross-border debt positions. Finally, estimates of the currency composition of official reserve assets are calculated through a combination of national data sources, COFER data and the implementation of the empirical model developed by Eichengreen and Mathieson (2000).

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<sup>2</sup>The process by which estimates of the currency composition of foreign liabilities are constructed is essentially symmetric.

<sup>3</sup>The BIS Statistics Department facilitated access to the underlying geographical and currency patterns in the locational banking data.

In the second step, the currency composition data for each category within foreign assets and foreign liabilities are combined to create aggregate weights, using the External Wealth of Nations dataset on the composition of international balance sheets (Lane and Milesi-Ferretti 2007).

The currency weights are given by the formulae

$$\omega_{ijt}^A = \sum_{k=1}^{k=N} \lambda_{it}^{Ak} * \omega_{ijt}^{Ak}, \quad \omega_{ijt}^L = \sum_{k=1}^{k=N} \lambda_{it}^{Lk} * \omega_{ijt}^{Lk} \quad (1)$$

where  $\omega_{ijt}^A, \omega_{ijt}^L$  are the weights for currency  $j$  in period  $t$  in country  $i$ 's foreign assets and foreign liabilities,  $\lambda_{it}^{Ak}, \lambda_{it}^{Lk}$  are the relative importance of category  $k$  (portfolio equity, FDI, debt, reserves) in country  $i$ 's assets and liabilities in period  $t$  and  $\omega_{ijt}^{Ak}, \omega_{ijt}^{Lk}$  are the weights for currency  $j$  in period  $t$  in category  $k$  for country  $i$ 's assets and liabilities respectively. Accordingly, the aggregate weights are a function of the weights for currency  $j$  in period  $t$  for a particular  $k$  asset-class of country  $i$ 's assets or liabilities, and the weights across the  $k$  asset classes (represented by  $\lambda_{it}^k$ ).

It is possible to define aggregate net financial weights

$$\omega_{ijt}^F = \omega_{ijt}^A s_{it}^A - \omega_{ijt}^L s_{it}^L \quad (2)$$

where  $s_{it}^A = A_{it}/(A_{it} + L_{it})$  and  $s_{it}^L = L_{it}/(A_{it} + L_{it})$  are the shares of foreign assets and foreign liabilities in total cross-border holdings. These weights indicate the direction of the valuation impact of a movement in currency  $j$ . If the net foreign asset position is zero, this reduces to simply subtracting the liability weights from the asset weights.

In turn, the quantitative exposure of country  $i$  to a shift in the bilateral exchange rate between  $i$  and  $j$  can be simply written as

$$NETFX_{ijt}^{BILAT} = \omega_{ijt}^F * IFI_{it} \quad (3)$$

where  $IFI_{it}$  is equal to assets plus liabilities as a percentage of GDP, or the total size of

the external balance sheet scaled by GDP, such that the valuation impact can be written as

$$VALXR_{ijt}^{BILAT} = NETFX_{ijt}^{BILAT} * \% \Delta E_{ijt}$$

where  $\% \Delta E_{ijt}$  is the percentage change in the bilateral exchange rate in period  $t$ .

In terms of aggregation across all bilateral currency pairs, it is helpful to define asset- and liability-weighted currency indices

$$I_t^A = I_{t-1}^A (1 + \sum \omega_{ijt-1}^A * \% \Delta E_{ijt}) \quad (4)$$

$$I_t^L = I_{t-1}^L (1 + \sum \omega_{ijt-1}^L * \% \Delta E_{ijt}) \quad (5)$$

In turn, the aggregate net financial index can be written as

$$I_t^F = I_{t-1}^F (1 + \sum \omega_{ijt-1}^F * \% \Delta E_{ijt}) \quad (6)$$

and the aggregate impact of currency-based valuation effects can be equivalently written as

$$VALXR_{it} = \% \Delta I_{it}^F * IFI_{it-1} \quad (7)$$

or

$$VALXR_{it} = \sum VALXR_{ijt}^{BILAT} = \sum NETFX_{ijt}^{BILAT} * \% \Delta E_{ijt} \quad (8)$$

By way of illustration, if 20 percent of a country's assets are in U.S. dollars and 30 percent of its liabilities are in dollars in a given year, and the country has a balanced NFA position (that is, assets equal liabilities), then the  $\omega_{ijt}^F = -0.05 = (0.2 * 0.5 - 0.3 * 0.5)$ . If assets plus liabilities are equivalent to 200 percent of the country's output, then  $NETFX_{ijt}^{BILAT}$  is  $-10$  percent. Thus a 10 percent depreciation of its currency against the dollar (holding fixed all other bilateral exchange rates) would generate a one percent of GDP wealth loss.

### 3 Swiss Currency Exposures and Valuation Effects

Using the framework described above, we turn to the study of Switzerland's foreign currency exposures for selected years in the 2002-2012 period. The reasons for focusing on this period are: (i) it contains estimates for currency composition with the highest quality, as data from sources such as the CPIS are available from 2001; (ii) it accounts for the increase in international financial integration following the launch of the euro; and (iii) it contains a sufficiently long tranquil period as well as the recent crisis.

We define the aggregate foreign currency exposure at the end of period  $t$  by

$$FXAGG_{it} = \omega_{it}^A s_{it}^A - \omega_{it}^L s_{it}^L \quad (9)$$

where  $\omega_{it}^A$  is the share of foreign assets denominated in foreign currencies,  $s_{it}^A$  is the share of foreign assets in the sum of foreign assets and foreign liabilities and  $\omega_{it}^L, s_{it}^L$  are defined analogously. By construction, the  $FXAGG$  index lies in the range  $(-1, 1)$ , where a value of  $-1$  corresponds to a country that has zero foreign-currency foreign assets and only foreign-currency foreign liabilities, whereas  $+1$  corresponds to a country that has only foreign-currency foreign assets and only domestic-currency foreign liabilities. In turn, the scale of the aggregate foreign currency exposure is given by

$$NETFX_{it} = FXAGG_{it} * IFI_{it}. \quad (10)$$

Table 1 shows Swiss foreign currency exposure for 2002, 2007 and 2012. We select these years, since 2002 marks the beginning of a general surge in cross-border financial trade, while 2007 represents the eve of the global financial crisis and 2012 is the final year in the sample (see also Lane 2013). It shows the  $FXAGG$  index defined by equation (9). In addition, it reports a decomposition of  $FXAGG$  between the net currency exposures embedded in the foreign asset position and foreign liability positions (each scaled by total foreign assets plus liabilities), plus the net foreign liability position in Swiss Francs. These



items are reported in rows (1), (2) and (3), respectively.

Furthermore, Table 1 also reports a decomposition of the net foreign asset position into the non-reserve net position and the reserve position in rows (4) and (5), respectively. Moreover, the net foreign liability position in Swiss Francs, reported in row (3), is decomposed into portfolio equity and FDI liabilities in row (6), debt liabilities in Swiss Francs in row (7), and non-reserve foreign assets denominated in Swiss Francs, in row (8).<sup>4</sup>

Finally, we also report the *NETFX* index as defined in equation (10) and the debt-only foreign currency exposure. The former explicitly accounts for the quantitative exposure to a uniform change in the value of domestic currency against all foreign currencies. More precisely, it measures the scale of the aggregate net currency exposure. The latter is an index analogous to the *FXAGG* but computed for foreign debt assets and liabilities only. This debt-only index helps to clarify the relative importance of debt and equity components in the aggregate index.

Table 1 shows that Switzerland was long in foreign currency in 2002, 2007 and 2012, and that its long position increased after the crisis. This raise in the Swiss long position was associated with an increase in its net foreign asset position and in its net liability position denominated in Swiss Francs (*FXAGG*<sup>0</sup>). The increase in the former between 2007 and 2012 was mainly driven by an increase in foreign exchange reserves, while the increase in the latter was mainly associated with an increase in equity liabilities and in debt liabilities denominated in Swiss Francs.

The scale of the exposure to foreign currencies increased secularly across these years. This was not only driven by the change in *FXAGG* but also by the increase in the scale of gross foreign assets and liability positions. More precisely, the *NETFX* values in row (9) show that this long position represented 2.6 times Swiss GDP in 2002, 3.4 times in 2007 and 3.7 times in 2012. In terms of the debt-only foreign exposures reported in row (10), Table 1 shows that this also grew between 2007 and 2012.

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<sup>4</sup>Lane and Shambaugh (2010a) and Bénétrix et al (2015) assume that the currency exposures of portfolio equity and FDI positions track the geographic exposure. Thus, Switzerland's portfolio equity and FDI liabilities are assumed to be effectively denominated in Swiss Francs. That is, the foreign-currency value of these assets moves with the value of the Swiss Franc.

Next, we employ the calculated international currency exposures to estimate the valuation impact of exchange rate movements on the net international investment position.

Figure 1 shows Swiss *VALXR* for the period 2002-2012 as well as its cumulative value. As expected, the largest valuation loss was associated with the Swiss Franc appreciation (vis-à-vis all currencies) between 2007 and 2008. This exchange rate shift, combined with the long position in foreign currency, generated a valuation loss of nearly 41 percent of Swiss GDP. The second largest valuation loss in this period was associated with the appreciation of the Swiss Franc between 2009 and 2010. This generated a valuation loss of 34 percent of GDP.

Overall, the Swiss long position in foreign currency combined with cumulative appreciation of the Swiss Franc generated sizable valuation losses.<sup>5</sup> This adverse valuation impact of exchange rate appreciation has been accentuated in the years following the crisis as Switzerland exhibited an increase in the volume of foreign liabilities denominated in domestic currency and an increase in official reserve assets.

## 4 Cross-Country Exposures to the Swiss Franc: Stylised Facts

This section documents the exposure to the Swiss Franc using a sample of 116 countries, consisting of 21 advanced economies and 95 emerging and developing countries. As before, we focus on the period from 2002 to 2012.

Figure 2 reports the cross-country distributions exposures to Swiss Francs, using period averages for 2002-2012 of the  $FXAGG^{CHF}$  index. It shows that more than half of the countries are long Swiss Francs. From the advanced economies group, 33 percent were long, while 62 percent of emerging and developing countries were long. A comparison

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<sup>5</sup>Of course, valuation losses can be counterbalanced by valuation gains as a result of changes in the value of foreign assets or liabilities that are not associated with exchange rate movements. For instance, in 2007 Switzerland exhibited a valuation loss associated with exchange rate changes of 3.1 percent of GDP. However, the overall stock-flow adjustment for that year was a gain of 13 percent of GDP.

between these two country types shows that, within the set of countries that are long, emerging and developing countries are more heavily weighted towards the Swiss Franc. For the set of countries that are short, the advanced countries tend to have a more negative weighting on Swiss Francs than the emerging and developing countries.

Tables 2 and 3 complement these stylised facts by reporting several statistics to characterise the  $FXAGG^{CHF}$  and  $NETFX^{CHF}$  distributions and their evolution in time. We look at these measures for the overall international investment position and the debt-only subcomponent.

Table 2 shows that the average  $FXAGG^{CHF}$  increased substantially for all countries between 2002 and 2012. The  $FXAGG^{CHF}$  mean value rose from 0.08 to 0.38, while its median grew from 0.08 to 0.13. Looking at these statistics by country type reveals that this increase was driven by few emerging and developing countries. For this group, the mean  $FXAGG^{CHF}$  value increased substantially but the median value only increased marginally. This is confirmed by the changes in the tenth percentile for these countries between 2002 and 2012.

In terms of the values before and after the crisis, the average and the median  $FXAGG^{CHF}$  also increased between 2007 and 2012. As for the full period, this is driven by the increase in the emerging market and developing countries exposure to the Swiss Franc in those years. The dynamics for the advanced group between 2007 and 2012 is different: the mean and median  $FXAGG^{CHF}$  values decline but remain positive in 2012.

The second panel of Table 2 shows the same statistics for  $NETFX^{CHF}$ . Thus, these statistics explicitly account for the size of the international balance sheet, as measured by the  $IFI$  index in equation (10). An inspection of this panel shows that the relatively higher weights on Swiss Francs for emerging and developing countries with respect to the advanced group do not mean a larger scale in their Swiss Franc position, in view of the smaller international balance sheets of this group.

Next, we focus on the debt-only component. Table 3 reports these statistics and the same country groups as before. We label  $FXAGG\_DEBT^{CHF}$  the debt-only version of

$FXAGG^{CHF}$  and  $NETFX\_DEBT^{CHF}$  the debt-only version of  $NETFX^{CHF}$ . While advanced economies exhibit a secular shift towards a less negative  $NETFX\_DEBT^{CHF}$  over 2002-2012, the emerging and developing countries saw a reversal between 2007-2012 compared to 2002-2007, with the contraction in the long  $NETFX\_DEBT^{CHF}$  position between 2002 and 2007 offset by an increase in net holdings of debt instruments denominated in Swiss Francs during 2007-2012.

Next, we compare exposures to the Swiss Franc with exposures to other foreign currencies. To this end, Figure 4 reports the 2002-2012 period average of the  $FXAGG$  index for the Swiss Franc and the aggregate of other currencies and shows that the range of exposures vis-à-vis the Swiss Franc is much smaller than the cross-country exposure vis-à-vis other currencies. The shape of this distribution is dominated by the cross-country exposures to the US dollar, the euro and, to a lesser extent, exposures vis-à-vis the British pound and the Japanese Yen. This is the case for the 2002-2012 period average and also for each individual year. In terms of the proportion of countries being long ‘other currencies’ and long Swiss Franc, Figure 4 shows that these shares were 38 and 58 percent, respectively.

Another way of looking at the relation between these exposures is by means of scatter plots and correlations for different years. Figure 5 reports the scatter plots for 2002, 2007, 2010 and 2012. The immediate message of these figures is that, independently of the year being studied, the correlations between  $FXAGG$  exposures for the Swiss Franc and other currencies were quite low. The correlation was positive and equal to 0.13 and 0.14 for 2002 and 2007 respectively, and negative and equal to -0.01 and -0.002 in 2010 and 2012 respectively.

However, the weak correlations in the full sample obscure some important differences between the advanced and emerging/developing subsamples. For advanced economies, exposures to the Swiss Franc were positively correlated with exposures to other currencies. This positive correlation reached its peak in 2005 with a value of 0.53 and then declined

until 2012.<sup>6</sup> Correlations for the emerging and developing countries group were weak in the whole period.<sup>7</sup> This indicates that the small change in the correlation coefficient in the overall sample from a small and positive correlation to a small and negative correlation can be attributed to the change in sign in the correlation for emerging and developing countries and the reduction in the positive correlation coefficient in advanced economies.

Beyond the analysis of the unconditional correlation between these exposures, it is useful to take a closer look at the countries that hold a long position in Swiss Francs and a short position in other currencies. These countries are reported in Figure 5 for the same years as before and represent 24-41 percent of the full sample: nearly all are emerging or developing economies. This is in line with the previous finding that this country group exhibits a mild negative correlation for these currency exposures.

Finally, we focus on the changes in exposures following the crisis by graphically illustrating the heterogeneous changes in currency exposures between the years 2007 and 2012. To this end, we select the sub-sample of countries exhibiting a change towards a more positive (or less negative) net position in Swiss Francs in 2012. This represents 54 percent of our country sample (63 countries), including 53 emerging and developing countries. Figure 6 reports the initial and end exposures of these economies. Hollowed circles show exposures in Swiss Francs and other currencies in 2007 while filled circles show these in 2012. Dashed vectors indicate the direction of this change. As this figure shows, there has been substantial heterogeneity in the changes of exposures vis-à-vis other foreign currencies. Thirty-one countries moved to a more positive position, twenty-seven stayed long in Swiss and also in other currencies while only five countries were long both and became short in other currencies after the crisis. This simple exercise illustrates the large variety of changes in exposures only for those countries moving to a more positive position in Swiss Francs. Next, we follow a more systematic approach and look at the

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<sup>6</sup>For the years 2002, 2007, 2010 and 2012, the correlation coefficients for advanced economies were 0.27, 0.44, 0.31 and 0.18, respectively.

<sup>7</sup>For emerging and developing countries, these correlation were positive and equal to 0.13 and 0.11 in 2002 and 2007, but then turned to negative and equal to -0.04 and -0.007 in 2007 and 2012, respectively.

covariates of Swiss currency exposures.<sup>8</sup>

## 4.1 Covariates of Country Exposures to the Swiss Franc

This section studies the covariates of exposures to the Swiss Franc. As shown in Table 1, it is possible to compute a number of key covariates for aggregate foreign exposures. The aggregate net international investment position and the net liability position in domestic currencies are key covariates of the net foreign currency position. For a given net international investment position, the distribution of the non-reserve position is especially influential (in particular, the shares of portfolio equity and FDI in foreign liabilities). The level of reserves is also important in the variance decomposition of the  $FXAGG$  positions.

In terms of the fundamental factors that covary with foreign currency positions, Lane and Shambaugh (2010b) and Bénétrix et al (2015) show that international trade patterns, risk characteristics and institutional factors are associated with the cross-country variation of aggregate foreign exposures. Here, we adapt the empirical approach to study the cross-country variation of bilateral exposures to the Swiss Franc. To this end, we estimate equation (11),

$$\begin{aligned} FXAGG_{it}^{CHF} = & \beta_1 FXAGG_{it}^{OTH} + \beta_2 IFI_{it} + \beta_3 \mathbf{TRADE}_{it} + \beta_4 \mathbf{VOL}_{it} + \beta_5 COV_{it} + \\ & \beta_6 IDIFF_{it} + \beta_7 \mathbf{Z}_{it} + \beta_8 GDP_{it}^{PC} + \beta_9 SIZE_{it} + \theta \mathbf{Y}_t + \varepsilon_{it}, \end{aligned} \quad (11)$$

where  $FXAGG_{it}^{CHF}$  measures the degree of exposure to the Swiss Franc and  $FXAGG_{it}^{OTH}$  is the exposure to other foreign currencies.<sup>9</sup> As shown in the previous section, the unconditional correlation between the exposure to the Swiss Franc and to other currencies is small for the full sample and for emerging and developing economies. However, these indices are positively correlated in advanced countries. Thus, we include this indicator as

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<sup>8</sup>Extensions of this work would include estimating the relative importance of exposures to the Swiss Franc in overall currency-induced valuations effects, as well as decomposition exercises to account for the role of changes in the currency weights or in the scale of the international balance sheet.

<sup>9</sup>These two indicators are defined in equation (2).

a control variable, so that our focus is on how the other regressors covary with the relative importance of Swiss Francs compared to other currencies in the international balance sheet.

In addition to the currency dimension of the international investment portfolio, we include an index to account for its size ( $IFI_{it}$ ). This is the de-facto international financial integration indicator defined as the sum of total foreign assets plus total foreign liabilities scaled by GDP (Lane and Milesi-Ferretti 2007).

In relation to other covariates,  $\mathbf{TRADE}_{it}$  is a vector that includes exports and imports vis-a-vis Switzerland. We add this to account for the fact bilateral financial positions are highly correlated with bilateral trade.<sup>10</sup>

In addition, we include different volatility measures in vector  $\mathbf{VOL}_{it}$ . Output volatility and inflation volatility are included to account for the effect of domestic instability and uncertainty, and bilateral exchange rate volatility to account for exchange rate risk. Furthermore, we add the covariance between the change in domestic wealth, proxied by real GDP per capita, and the exchange rate appreciation vis-à-vis the Swiss Franc ( $COV_{it}$ ) as a possible factor determining long or short positions.<sup>11</sup>

Taking into account that investors may engage in carry trade activities that could determine the extent of exposures to the Swiss Franc, we include interest rate differentials for long term bonds ( $IDIFF_{it}$ ) as an additional explanatory variable.<sup>12</sup>

Since institutional and policy factors may alter the desired optimal currency exposure and/or restrict the ability to attain its desired level, we add indicators for exchange rate pegs, capital controls, quality of institutions and EMU membership in vector  $\mathbf{Z}_{it}$ .  $GDP_{it}^{PC}$  is the level of GDP per capita and it is included as a general control variable since many

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<sup>10</sup>Several papers exploit this strong correlation to generate estimates of bilateral financial positions. Examples of these works are Lane and Shambaugh (2010b) or Bénétrix, Lane and Shambaugh (2015) among others.

<sup>11</sup>These variance and covariance measures are calculated for the log changes of each variable using a fifteen-year window. For instance, in year 1996 these statistics are computed using data for the period 1981-1995.

<sup>12</sup>In the years preceding the crisis, a standard carry trade strategy was to raise funding in low-yield currencies such as the Japanese Yen or the Swiss Franc and take long positions backed by high interest rate currencies such as the Australian or New Zealand dollars.

of the characteristics listed above are plausibly correlated with the level of development.  $SIZE_{it}$  is country size measured by the logarithm of population. This is included as a general control variable, following the empirical evidence in Lane and Milesi-Ferretti (2000) and Eichengreen et al (2003) showing that larger countries (all else equal) are better able to issue liabilities in domestic currency.

We estimate this equation by pooling data for the years 1996, 2000, 2004, 2007 and 2012. We follow this approach, instead of including all years, to avoid potential problems that could be created by variables with high serial correlation. In addition, we want to minimize the impact of using regressors, such as the volatilities and covariances that are based on period windows that overlap with each other. Finally, there is also a data availability limitation, since the World Bank institutional quality indicators are only available in even years.

## 4.2 Aggregate Exposures

Table 4 reports the point estimates of the coefficients in equation (11) for five alternative country samples using  $FXAGG_{it}^{CHF}$  as the dependent variable. First, we take all 116 countries together. Then, we consider four alternative subsamples. Column (2) reports the results for a sample of 61 higher-income countries.<sup>13</sup> Columns (3) and (4) report the results for the 21 advanced economies and 95 emerging plus developing countries while the estimates for 40 higher-income countries in the emerging plus developing sample are reported in column (5).

Table 4 shows that all the covariates described above account for less than 10 percent of the overall cross country variation in the aggregate Swiss Franc exposure in almost all samples. The exception is the model for the advanced economies, with 57 percent of the overall variation attributable to the included regressors.

In terms of the non-significance of the individual explanatory variables we find that:

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<sup>13</sup>This sample excludes very small and very poor countries (total dollar GDP below \$20 billion) on the presumption that these countries are more likely to suffer from data quality issues. For examples of papers using this high-quality sample see Bénétrix et al (2015) and Lane and Milesi-Ferretti (2012, 2014).



(i) there is no systematic link between exposures to the Swiss Franc and other currencies, in line with the unconditional correlations reported above (the exceptions are the specifications for the advanced and full samples showing a small and positive co-movement); (ii) exports to Switzerland do not affect aggregate exposures; (iii) GDP volatility, EMU membership and GDP per capita are also unimportant; and (iv) the insignificance of the time dummies for 2000, 2004 and 2007 show that Swiss Franc exposures were not subject to common movements during those years.

In terms of the individual significance of the included regressors, some interesting patterns emerge. Consistent with the unconditional correlations reported above, we find evidence of a positive link between long positions in other foreign currencies and long Swiss Franc positions in advanced countries.<sup>14</sup> In addition, the size of the international balance sheet matters for these countries and also in the high quality sample: larger international financial integration is associated with longer positions in Swiss Francs.

The link between Swiss Franc exposures and trade is present in advanced countries, with short positions in Swiss Francs associated with higher imports from Switzerland. The strength of this negative link is such that its significance also emerges in the high-quality and full samples, although with coefficients of smaller magnitude.

In terms of the covariance and risk measures, we find that a positive comovement between exchange rate depreciations vis-à-vis the Swiss Franc and slowdowns in GDP growth is relevant for aggregate Swiss Franc exposures in advanced countries: these countries benefit from positive valuation effects in scenarios in which GDP growth slows down and the exchange rate depreciates against the Swiss Franc.

In terms of the risk measures proxied by the volatility indicators, we find that more volatility in bilateral exchange rates is associated with shorter positions in Swiss Francs in the advanced sample.<sup>15</sup> Volatility measures included to account for domestic instability

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<sup>14</sup>This positive link also emerges as statistically significant in the specification including all countries. However, since this coefficient is statistically zero in all the other samples, we interpret this results as being driven by the positive correlation exhibited in advanced countries. In line with this, the size of this coefficient in the full sample is smaller than in the advanced group.

<sup>15</sup>This effect also emerges in the high-quality sample including all advanced countries.

and uncertainty are relevant in the other country samples. In particular, we find that inflation volatility is positively associated with long positions in the emerging/developing sample as well as in the high-quality and full samples. Domestic uncertainty proxied by GDP volatility, on the contrary, is insignificant across the board. This suggests that the uncertainty associated with prices plays a more important role for the determination of exposures than the uncertainty in relation to economic growth. In line with this, Table 4 shows that the exchange rate regime is relevant for Swiss Franc exposures in most country samples.

To account for the potential role of carry-trade activities in driving exposures to the Swiss Franc we also include the interest rate gap between Switzerland and the country in question. Table 4 shows that this variable is insignificant in three country samples. The exceptions are the emerging/developing sample and the full sample, where this variable is negative and statistically significant. To further check the robustness of this finding we also experimented with models including the change in the bilateral exchange rate as an additional explanatory variable.<sup>16</sup> Here, we find that the positive coefficient in the advanced sample becomes statistically significant and that the negative sign and significance of the coefficients in emerging plus developing and full samples do not change. In addition, we estimated a specification including the interaction term between the interest rate differential and the exchange rate with a dummy variable for 2012 to account for the impact of the recent global financial crisis. Here, we find that the interest rate coefficient in the pre-crisis years is positive but statistically zero in advanced, and negative and statistically significant in emerging plus developing and in the full samples. For the years after the crisis we find that the sign of the interest rate gap is positive in all samples and statistically significant in the high-quality and full samples only. Overall, these exercises show that once we condition for all the factors described above and also for the recent crisis, there is not a clear link between interest rate differentials and aggregate exposures to the Swiss Franc.

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<sup>16</sup>These regression models are not included to save space. However, they are available upon request.

We do not find strong evidence of institutional factors being relevant for aggregate exposures. The quality of institutions is relevant only for the emerging/developing sample, in which higher-quality institutions are associated with longer positions. However, this effect high-income subsample. In terms of the role of capital controls, Table 4 shows that this is significant and negatively associated with aggregate short Swiss Franc positions in advanced economies only. Finally, larger countries hold longer positions in Swiss Francs in the advanced and in the full samples.

### 4.3 The Covariates of Debt-Related Exposures

We repeat the econometric analysis for the debt-only measures. Table 5 reports the same set of regressions and country splits discussed before. It shows that these are able to explain a larger fraction of the variation in debt exposures in all samples.

Among the patterns that emerge for the debt-only measures, there is importance of exposures to other currencies for both high quality samples. In relation to the role of international financial integration this table shows that this is associated with long positions in advanced, high-quality and full samples. As before, the trade channel is important with imports being associated with short positions in the advanced and high-quality samples. However, exports are now significantly associated with short positions in the latter.

In line with the previous findings, Swiss Franc exposures play a stabilizing role for internal imbalances as a positive covariance between GDP growth and the exchange rate is associated with long positions. This implies that slowdowns in the GDP growth in advanced economies with their currency depreciating vis-à-vis the Swiss franc face capital gains in their net debt position denominated in the Swiss currency.

In relation to the risk measures, only a few variables are statistically significant: output volatility is significant for the high quality sample and the exchange rate volatility for the advanced sample. In contrast to the patterns for aggregate exposures, inflation volatility does not significantly covary with debt-only Swiss Franc exposures.

Debt-only exposures significantly covary with carry trade proxies: net debt positions in Swiss Francs are negatively related to the interest rate differential (with the exception of the advanced sample). As before, we also estimated versions including exchange rates and interaction terms with a crisis dummy. The former yields results that are in line with those reported in Table 5, with the exception of the advanced sample which shows a larger coefficient that is statistically significant. Therefore, if carry trade plays a role for these exposures, it does it for the debt component in advanced countries. Interestingly enough, the coefficients in all the other samples have the opposite sign.<sup>17</sup>

Debt exposures are also sensitive to the exchange rate regime. Peggers tend to be shorter in Swiss Francs in all samples with the exception of emerging plus developing countries.

In contrast to the aggregate exposure, higher-quality institutions are associated with short debt positions in the emerging/developing, high-quality and full samples, while capital controls are associated with positive debt exposures in advanced economies only. EMU membership is now a relevant factor, associated with longer debt-only positions in emerging plus developing countries.<sup>18</sup> The level of GDP per capita and country size negatively covary with net debt positions in the high positions in high-quality emerging plus developing. Country size also presents a negative coefficient in emerging plus developing, high-quality and full samples. However, this is positively associated with long debt positions in Swiss Fran in advanced countries.

In summary, the specifications for debt-only measures are more successful than those looking at aggregate exposures in terms of the overall variation explained by our set of covariates. In terms of the country splits, we find that most of the action takes place in advanced economies.

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<sup>17</sup>As before, we also estimated models including interaction terms for the interest rate differential and exchange rates with a crisis dummy variable and found that this specification does not yield statistically significant individual effects in the advanced sample. For emerging plus developing and high quality emerging plus developing the crisis period is not associated with a change on the impact of these variables. For the high quality and full samples, however, the interest rate differential is positive and statistically significant after the crisis.

<sup>18</sup>The following euro area countries are included in the emerging/developing sample: Estonia, Slovak Republic and Slovenia

## 5 Conclusions

This paper makes two contributions. First, we report the international currency exposures embedded in the Swiss international investment position. We show that Switzerland became increasingly long in foreign currencies over 2002-2012, which is consistent with the thirst by foreign investors for Swiss Franc assets (among other contributory factors). In addition, we exploit the estimated international currency exposures to quantify the adverse valuation impact generated by the appreciation of the Swiss Franc in recent years: this has been large relative to GDP, given the outsized scale of the Swiss international balance sheet.

Second, we examine the Swiss Franc positions held by a sample of 116 countries. We investigate the covariates of the cross-country and cross-time variation in these positions. We find that the average exposure across advanced economies was a long position in Swiss Francs for the aggregate international balance sheet but a short net position in the debt category. After the crisis, these positions were compressed: the overall long position became less positive and the debt short position became less negative. The average exposure across emerging and developing countries was a long position both in the aggregate international balance sheet and in the debt subcomponent. In contrast to the advanced group, these long positions became more positive after the crisis. In terms of the relation between exposures to the Swiss Franc and exposures to other foreign currencies, we find evidence of positive correlation in advanced economies. However, this correlation is low in emerging and developing countries.

Our study of the determinants of cross-country exposures to the Swiss Franc generates several findings. In general, most of the action takes place in advanced economies. For these countries, exposures to other foreign currencies, international financial integration, imports, the covariance of GDP growth and exchange rate appreciations, exchange rate volatility, capital controls and country size matter for their aggregate Swiss Franc exposure. For the other samples, we also find a selection of covariates that are individually relevant from a statistical point of view. Among them, the Swiss Franc position positively

covaries with inflation volatility and negatively with exchange rate pegs. However, our empirical specifications are unable to explain more than 10 percent of the overall variation in Swiss Franc exposures for these samples. By contrast, specifications focusing on the Swiss Franc exposures in the debt category are more successful.

In terms of the research agenda, the empirical approach in this paper could be applied to other major currencies. In addition, in relation to the Swiss Franc, it would be interesting to study the impact on international balance sheets of the January 2014 step revaluation of the Swiss Franc against the euro. We defer these questions to future research.

# Data Appendix

## Country List

- Advanced countries (22): Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Denmark (DNK), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Iceland (ISL), Ireland (IRL), Italy (ITA), Japan (JPN), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), United Kingdom (GBR) and United States (USA)
- Emerging market economies and developing countries (95): Albania (ALB), Algeria (DZA), Argentina (ARG), Armenia (ARM), Azerbaijan (AZE), Bangladesh (BGD), Belarus (BLR), Benin (BEN), Bolivia (BOL), Bosnia and Herzegovina (BIH), Botswana (BWA), Brazil (BRA), Burkina Faso (BFA), Cambodia (KHM), Cameroon (CMR), Chad (TCD), Chile (CHL), China (CHN), Colombia (COL), Congo, Rep. (COG), Cote d'Ivoire (CIV), Croatia (HRV), Czech Republic (CZE), Dominican Republic (DOM), Egypt (EGY), El Salvador (SLV), Equatorial Guinea (GNQ), Estonia (EST), Ethiopia (ETH), Fiji (FJI), Gabon (GAB), Georgia (GEO), Ghana (GHA), Guatemala (GTM), Guinea (GIN), Haiti (HTI), Honduras (HND), Hong Kong (HKG), Hungary (HUN), India (IND), Indonesia (IDN), Iran (IRN), Israel (ISR), Jamaica (JAM), Jordan (JOR), Kazakhstan (KAZ), Kenya (KEN), Korea, Republic of (KOR), Kyrgyz Republic (KGZ), Latvia (LVA), Lithuania (LTU), Macedonia, FYR (MKD), Madagascar (MDG), Malawi (MWI), Malaysia (MYS), Mali (MLI), Mexico (MEX), Moldova (MDA), Morocco (MAR), Mozambique (MOZ), Nepal (NPL), Nicaragua (NIC), Niger (NER), Nigeria (NGA), Oman (OMN), Pakistan (PAK), Papua New Guinea (PNG), Paraguay (PRY), Peru (PER), Philippines (PHL), Poland (POL), Romania (ROM), Russian Federation (RUS), Rwanda (RWA), Senegal (SEN), Singapore (SGP), Slovak Republic (SVK), Slovenia (SVN), South Africa (ZAF), Sri Lanka (LKA), Syrian Arab Republic (SYR), Tanzania (TZA), Thailand (THA), Togo (TGO), Trinidad and Tobago (TTO), Tunisia (TUN), Turkey (TUR), Turkmenistan (TKM), Uganda (UGA), Ukraine (UKR), Uruguay (URY), Venezuela (VEN), Vietnam (VNM), Yemen, Republic of (YEM) and Zambia (ZMB)
- High-quality sample (61): Argentina (ARG), Australia (AUS), Austria (AUT), Belarus (BLR), Belgium (BEL), Brazil (BRA), Canada (CAN), Chile (CHL), China, P.R. (CHN), Colombia (COL), Croatia (HRV), Czech Republic (CZE), Denmark (DNK), Dominican Republic (DOM), El Salvador (SLV), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Guatemala (GTM), Hong

Kong SAR of China (HKG), Hungary (HUN), Iceland (ISL), India (IND), Indonesia (IDN), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Korea, Republic of (KOR), Latvia (LVA), Lithuania (LTU), Malaysia (MYS), Mexico (MEX), Morocco (MAR), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Pakistan (PAK), Peru (PER), Philippines (PHL), Poland (POL), Portugal (PRT), Romania (ROM), Russian Federation (RUS), Singapore (SGP), Slovak Republic (SVK), Slovenia (SVN), South Africa (ZAF), Spain (ESP), Sri Lanka (LKA), Sweden (SWE), Switzerland (CHE), Thailand (THA), Tunisia (TUN), Turkey (TUR), Ukraine (UKR), United Kingdom (GBR), United States (USA) and Uruguay (URY)

## Data and Sources

The data to compute currency exposures are taken from Bénétrix, Lane and Shambaugh (2015), which is an updated and extended version of the original data in Lane and Shambaugh (2010a). The data sources for the variables in Tables 4 and 5 are the following: real GDP growth is from the International Monetary Fund’s (IMF) World Economic Outlook Database 2014. Stock-flow adjustment, net foreign assets and current account balance data are from the latest version of the External Wealth of Nations dataset (Lane and Milesi-Ferretti 2007). The source for stock market returns is MSCI Barra and national sources, while long term interest rates are taken from IMF’s International Financial Statistics (IFS) data base and from national sources. Exchange rate regime data (peg and no peg) are from Klein and Shambaugh (2008). Trade openness, population, and per capita income are taken from World Bank’s (WB) World Development Indicators. Nominal effective exchange rate (NEER) is sourced from IMF’s IFS and Bank for International Settlements. The source for consumer price index (CPI) and nominal exchange rate is IMF’s IFS; World Governance Indicators from World Bank; and the Chinn-Ito Capital Account Openness index from the website [http://web.pdx.edu/~ito/Chinn-Ito\\_website.htm](http://web.pdx.edu/~ito/Chinn-Ito_website.htm).

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Table 1: Decomposition of Swiss Foreign exposure

	2002	2007	2012
(1) $FXAGG$	0.29	0.28	0.37
(2) $(A - L)/(A + L)$	0.14	0.11	0.14
(3) $FXAGG^0$	0.14	0.17	0.23
$(A - L)/(A + L) = (4) + (5)$			
(4) $(A_{NR} - L)/(A + L)$	0.13	0.10	0.07
(5) $FXR/(A + L)$	0.02	0.01	0.07
$FXAGG^0 = (6) + (7) - (8)$			
(6) $(PEQL + FDIL)/(A + L)$	0.17	0.20	0.23
(7) $DEBTL^{DC}/(A + L)$	0.04	0.02	0.07
(8) $A_{NR}^{DC}/(A + L)$	0.07	0.06	0.07
(9) $NETFX$	2.63	3.38	3.74
(10) $FXAGG\_DEBT$	0.15	0.11	0.22

**Note:**  $FXAGG$  is the aggregate foreign exposure defined in equation (9),  $(A - L)$  is the net foreign asset position.  $A$  are total foreign assets and  $L$  are foreign liabilities. Row (2) = (4) + (5).  $FXAGG^0$  is the net foreign liability position in domestic currency and (3) = (6) + (7) - (8).  $(A_{NR} - L)$  is the non-reserve net foreign asset position.  $FXR$  are foreign exchange reserves,  $(PEQL + FDIL)$  are portfolio equity and FDI liabilities. These are denominated in Swiss Franc.  $DEBTL^{DC}$  are debt liabilities in Swiss Francs.  $A_{NR}^{DC}$  are non-reserve foreign assets denominated in Swiss Francs.  $NETFX$  is defined in equation (10) and measures the quantitative exposure to a uniform shift in the value of the domestic currency against all foreign currencies.  $FXAGG\_DEBT$  is a measure of foreign currency exposure analogous to  $FXAGG$  but for debt only.

Table 2: Exposures to Swiss Franc.

$$FXAGG^{CHF}$$

Group	Year	10 <sup>th</sup> Percentile	Mean	Median	90 <sup>th</sup> Percentile
ALL	2002	-0.28	0.08	0.08	0.65
	2007	-0.15	0.12	0.10	0.68
	2012	-0.10	0.38	0.13	0.82
ADV	2002	-0.09	0.06	0.28	0.83
	2007	-0.34	0.26	0.43	0.84
	2012	-0.32	0.22	0.28	0.82
EMDEV	2002	-0.28	0.09	0.07	0.51
	2007	-0.10	0.09	0.08	0.50
	2012	-0.004	0.41	0.11	0.77

$$NETFX^{CHF}$$

Group	Year	10 <sup>th</sup> Percentile	Mean	Median	90 <sup>th</sup> Percentile
ALL	2002	-0.36	0.13	0.12	1.69
	2007	-0.21	0.36	0.12	1.86
	2012	-0.04	1.40	0.17	2.32
ADV	2002	-0.16	0.28	0.92	2.76
	2007	-3.98	1.44	1.86	5.36
	2012	-1.64	1.98	1.39	6.74
EMDEV	2002	-0.36	0.10	0.07	0.70
	2007	-0.18	0.12	0.08	0.80
	2012	-0.002	1.27	0.14	1.61

**Note:** Statistics computed using a sample of 21 advanced economies and 95 emerging and developing countries.  $FXAGG^{CHF}$  is defined by equation (2) while  $NETFX^{CHF}$  is defined by equation (3).

Table 3: Exposures to Swiss Franc. Foreign debt only.

*FXAGG\_DEBT<sup>CHF</sup>*

Group	Year	10 <sup>th</sup> Percentile	Mean	Median	90 <sup>th</sup> Percentile
ALL	2002	-1.16	0.11	0.24	1.19
	2007	-0.73	0.01	0.12	0.81
	2012	-0.84	0.15	0.13	1.23
ADV	2002	-1.63	-1.14	-0.62	-0.10
	2007	-1.17	-0.74	-0.39	0.06
	2012	-1.38	-0.64	-0.44	0.11
EMDEV	2002	-0.38	0.44	0.35	1.49
	2007	-0.07	0.21	0.17	0.87
	2012	-0.01	0.36	0.21	1.26

*NETFX\_DEBT<sup>CHF</sup>*

Group	Year	10 <sup>th</sup> Percentile	Mean	Median	90 <sup>th</sup> Percentile
ALL	2002	-1.96	-0.27	0.15	1.08
	2007	-2.51	-0.49	0.06	0.69
	2012	-1.56	-0.01	0.09	1.17
ADV	2002	-3.73	-2.76	-1.52	-0.14
	2007	-4.89	-2.48	-1.26	0.19
	2012	-7.14	-1.31	-0.80	0.72
EMDEV	2002	-0.30	0.39	0.30	1.21
	2007	-0.05	0.04	0.09	0.78
	2012	-0.004	0.34	0.12	1.38

**Note:** Statistics computed using a sample of 21 advanced economies and 95 emerging and developing countries. *FXAGG\_DEBT<sup>CHF</sup>* is analogous to equation (2) while *NETFX\_DEBT<sup>CHF</sup>* is analogous to equation (3) with the difference that these are based on foreign debt only.

Table 4: Determinants of exposures to the Swiss Franc

$FXAGG^{CHF}$	(1) ALL	(2) HQ	(3) ADV	(4) EMDEV	(5) EMDEV HQ
$FXBILAT^{OTH}$	0.004* (0.002)	0.006 (0.004)	0.015* (0.008)	0.002 (0.002)	0.000 (0.006)
$IFI$	0.026 (0.017)	0.053** (0.024)	0.056* (0.032)	-0.016 (0.028)	0.040 (0.047)
Exports	0.002 (0.020)	-0.234 (0.269)	-0.556 (0.419)	0.022 (0.025)	0.545 (0.399)
Imports	-0.271** (0.137)	-0.503*** (0.159)	-1.201*** (0.395)	0.015 (0.159)	-0.479 (0.385)
Vol(GDP)	-0.005 (0.014)	0.033 (0.035)	0.214 (0.171)	-0.003 (0.014)	-0.019 (0.031)
Cov(GDP,E)	-0.000 (0.000)	0.001 (0.001)	0.052*** (0.013)	-0.000 (0.000)	0.000 (0.001)
Vol( $\pi$ )	0.026*** (0.008)	0.020* (0.011)	-0.440 (0.325)	0.021*** (0.008)	0.013 (0.009)
Vol(E)	-0.008 (0.010)	-0.060** (0.030)	-0.515*** (0.164)	-0.004 (0.010)	-0.022 (0.029)
IDIFF	-0.013** (0.006)	-0.010 (0.009)	0.026 (0.039)	-0.011* (0.007)	-0.008 (0.010)
Peg	-0.240*** (0.093)	-0.376** (0.180)	-0.304 (0.312)	-0.249*** (0.091)	-0.385** (0.190)
Capital Controls	-0.021 (0.036)	-0.030 (0.095)	0.735*** (0.163)	-0.022 (0.035)	0.037 (0.087)
Institutions	-0.036 (0.066)	-0.173 (0.138)	-0.002 (0.324)	0.154* (0.093)	0.309 (0.199)
EMU	-0.081 (0.219)	0.114 (0.322)	0.476 (0.426)	0.024 (0.308)	-0.240 (0.593)
$GDP^{PC}$	0.081 (0.053)	0.047 (0.126)	0.513 (0.553)	0.070 (0.056)	-0.186 (0.137)
Size	0.036* (0.021)	0.010 (0.041)	0.333*** (0.090)	0.003 (0.024)	-0.084 (0.057)
Year 1996	-0.879* (0.515)	-0.175 (1.203)	-3.425 (5.452)	-0.522 (0.559)	2.310* (1.378)
Year 2000	0.291 (0.189)	0.379 (0.255)	0.345 (0.337)	0.109 (0.214)	0.065 (0.345)
Year 2004	0.261 (0.187)	0.256 (0.250)	-0.007 (0.423)	0.094 (0.216)	0.035 (0.330)
Year 2007	0.235 (0.189)	0.153 (0.255)	-0.017 (0.519)	0.088 (0.221)	-0.011 (0.341)
Year 2012	0.470** (0.232)	0.452 (0.395)	-0.120 (0.443)	0.403 (0.273)	0.553 (0.568)
Observations	524	273	105	419	168
$R^2$	0.078	0.094	0.570	0.081	0.083

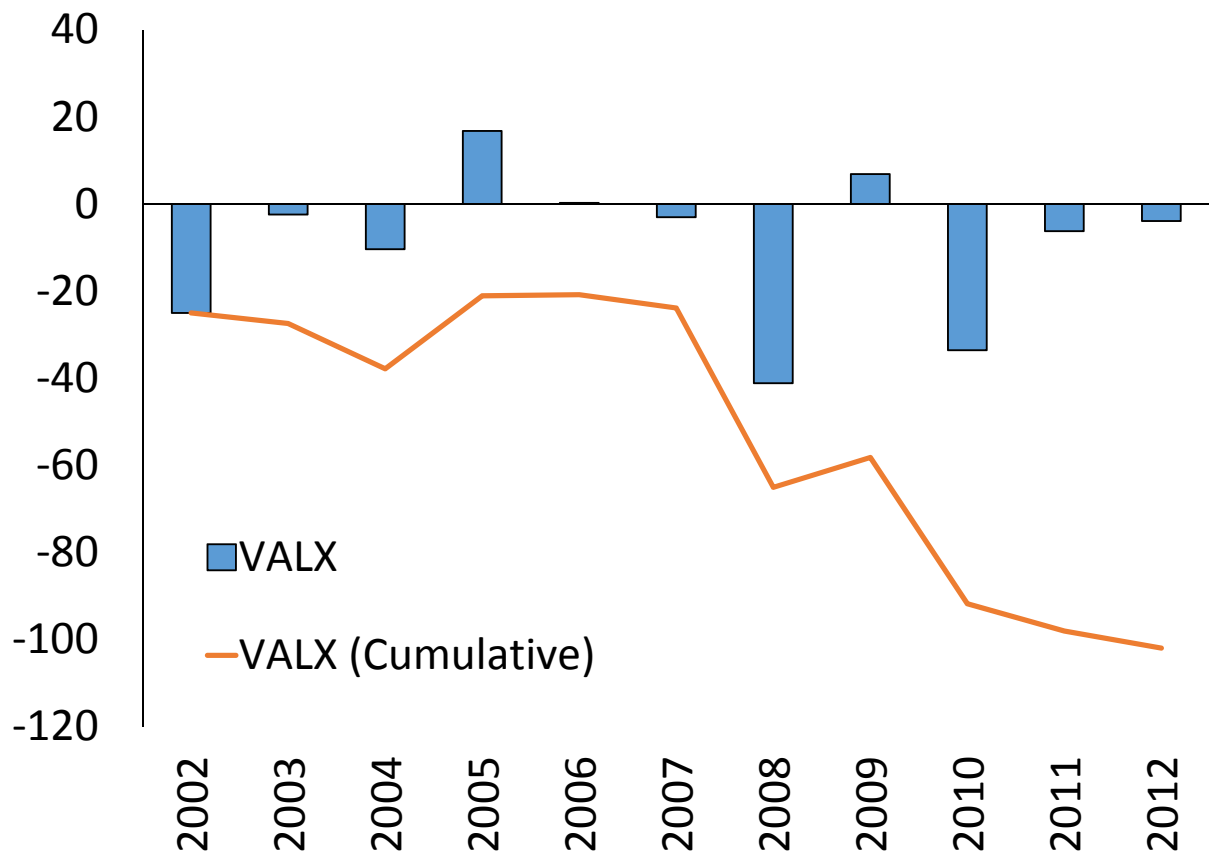
**Note:** Pooled regressions based on data for 1996, 2000, 2004, 2007 and 2012. Robust standard errors are in parentheses. Statistical significance is as follows \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .  $FXAGG^{CHF}$  is aggregate exposure in Swiss Francs;  $FXAGG^{OTH}$  is the aggregate exposure in other foreign currencies;  $IFI$  is the sum of foreign assets plus foreign liabilities scaled by GDP; Exports and Imports are to and from Switzerland and are scaled by GDP; Vol(GDP) is the standard deviation of year-on-year GDP growth; Vol( $\pi$ ) is the standard deviation of month-on-month CPI inflation; Vol(E) is the standard deviation of month-on-month change in the bilateral nominal exchange; Cov(GDP,E) is the covariance between GDP growth and NEER change (All measures of volatilities and covariance are computed using a 15-year window.); IDIFF is the difference between the long term interest rates in Switzerland and the country in question; Peg is a dummy variable that takes value 1 for countries with either peg or soft pegs as defined by Shambaugh (2004); Capital controls are the Chinn-Ito's Capital Account Openness Index multiplied by -1; Institutions refers to World Bank Governance Indicators estimates; EMU is a dummy variable for EMU member countries;  $GDP^{PC}$  is GDP per capita in log levels. Size is the logarithm of population. Finally, Year 1996, 2000, 2004, 2007 and 2012 are year dummy variables.

Table 5: Determinants of exposures to the Swiss Franc (debt only)

$FXAGG\_DEBT^{CHF}$	(1) ALL	(2) HQ	(3) ADV	(4) EMDEV	(5) EMDEV HQ
$FXAGG\_DEBT^{OTH}$	-0.004 (0.005)	0.017*** (0.005)	0.004 (0.013)	-0.006 (0.006)	0.011** (0.005)
$IFI^{DEBT}$	0.085** (0.039)	0.163*** (0.054)	0.180** (0.072)	-0.043 (0.056)	0.003 (0.048)
Exports	0.036 (0.051)	-0.927** (0.409)	-0.702 (0.617)	0.088 (0.065)	0.323* (0.186)
Imports	-0.269 (0.254)	-0.437* (0.245)	-2.569*** (0.706)	0.340 (0.213)	0.125 (0.239)
Vol(GDP)	0.011 (0.031)	0.152** (0.063)	0.360 (0.289)	0.011 (0.030)	0.081 (0.051)
Cov(GDP,E)	-0.001 (0.001)	0.002 (0.002)	0.042** (0.019)	-0.001 (0.001)	0.001 (0.002)
Vol( $\pi$ )	0.052 (0.037)	-0.010 (0.022)	-0.186 (0.470)	0.042 (0.037)	-0.019 (0.018)
Vol(E)	-0.029 (0.026)	-0.066 (0.057)	-0.515** (0.256)	-0.027 (0.026)	-0.019 (0.051)
IDIFF	-0.040*** (0.013)	-0.021* (0.011)	0.073 (0.072)	-0.038*** (0.014)	-0.032** (0.013)
Peg	-0.277* (0.149)	-0.605*** (0.229)	-0.819* (0.484)	-0.169 (0.144)	-0.297** (0.147)
Capital Controls	0.030 (0.058)	0.049 (0.074)	1.203*** (0.230)	0.009 (0.055)	0.051 (0.060)
Institutions	-0.564*** (0.160)	-0.546*** (0.191)	-0.702 (0.453)	-0.307* (0.175)	-0.088 (0.195)
EMU	-0.483 (0.363)	0.138 (0.341)	0.513 (0.600)	0.724*** (0.274)	0.468 (0.303)
$GDP^{PC}$	0.093 (0.119)	-0.189 (0.171)	-1.648* (0.935)	0.039 (0.117)	-0.514*** (0.159)
Size	-0.102** (0.046)	-0.132** (0.051)	0.338* (0.170)	-0.134** (0.055)	-0.171*** (0.054)
Year 1996	-0.831 (0.982)	2.363* (1.377)	19.532** (9.270)	-0.064 (0.972)	4.941*** (1.452)
Year 2000	0.405 (0.346)	0.592* (0.313)	1.061* (0.542)	0.103 (0.384)	0.282 (0.258)
Year 2004	0.453 (0.347)	0.595* (0.332)	0.939 (0.688)	0.137 (0.391)	0.538** (0.231)
Year 2007	0.320 (0.335)	0.367 (0.323)	1.385* (0.821)	-0.042 (0.372)	0.278 (0.241)
Year 2012	0.408 (0.337)	0.424 (0.333)	1.519** (0.712)	0.089 (0.375)	0.327 (0.283)
Observations	524	273	105	419	168
$R^2$	0.165	0.388	0.629	0.094	0.344

**Note:** Pooled regressions based on data for 1996, 2000, 2004, 2007 and 2012. Robust standard errors are in parentheses. Statistical significance is as follows \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .  $FXAGG\_DEBT^{CHF}$  is debt-only exposure in Swiss Francs;  $FXAGG\_DEBT^{OTH}$  is the debt-only exposure in other foreign currencies;  $IFI^{DEBT}$  is the sum of foreign debt assets plus foreign debt liabilities scaled by GDP; Exports and Imports are to and from Switzerland and are scaled by GDP; Vol(GDP) is the standard deviation of year-on-year GDP growth; Vol( $\pi$ ) is the standard deviation of month-on-month CPI inflation; Vol(E) is the standard deviation of month-on-month change in the bilateral nominal exchange; Cov(GDP,E) is the covariance between GDP growth and NEER change (All measures of volatilities and covariance are computed using a 15-year window.); IDIFF is the difference between the long term interest rates in Switzerland and the country in question; Peg is a dummy variable that takes value 1 for countries with either peg or soft pegs as defined by Shambaugh (2004); Capital controls are the Chinn-Ito's Capital Account Openness Index multiplied by -1; Institutions refers to World Bank Governance Indicators estimates; EMU is a dummy variable for EMU member countries;  $GDP^{PC}$  is GDP per capita in log levels. Size is the logarithm of population. Finally, Year 1996, 2000, 2004, 2007 and 2012 are year dummy variables.

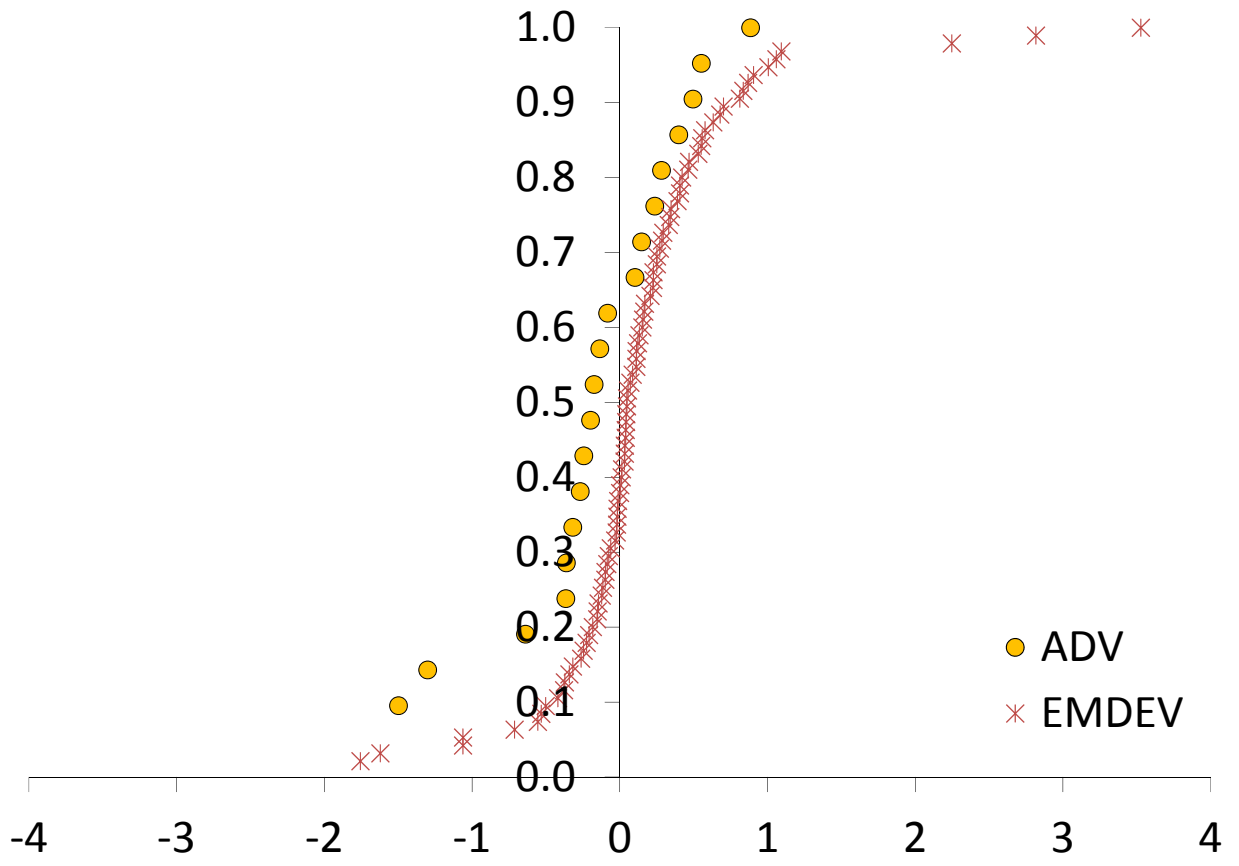
Figure 1: Swiss *VALX*



**Note:** *VALX* is the exchange rate-induced valuation effect as defined in equation (8).

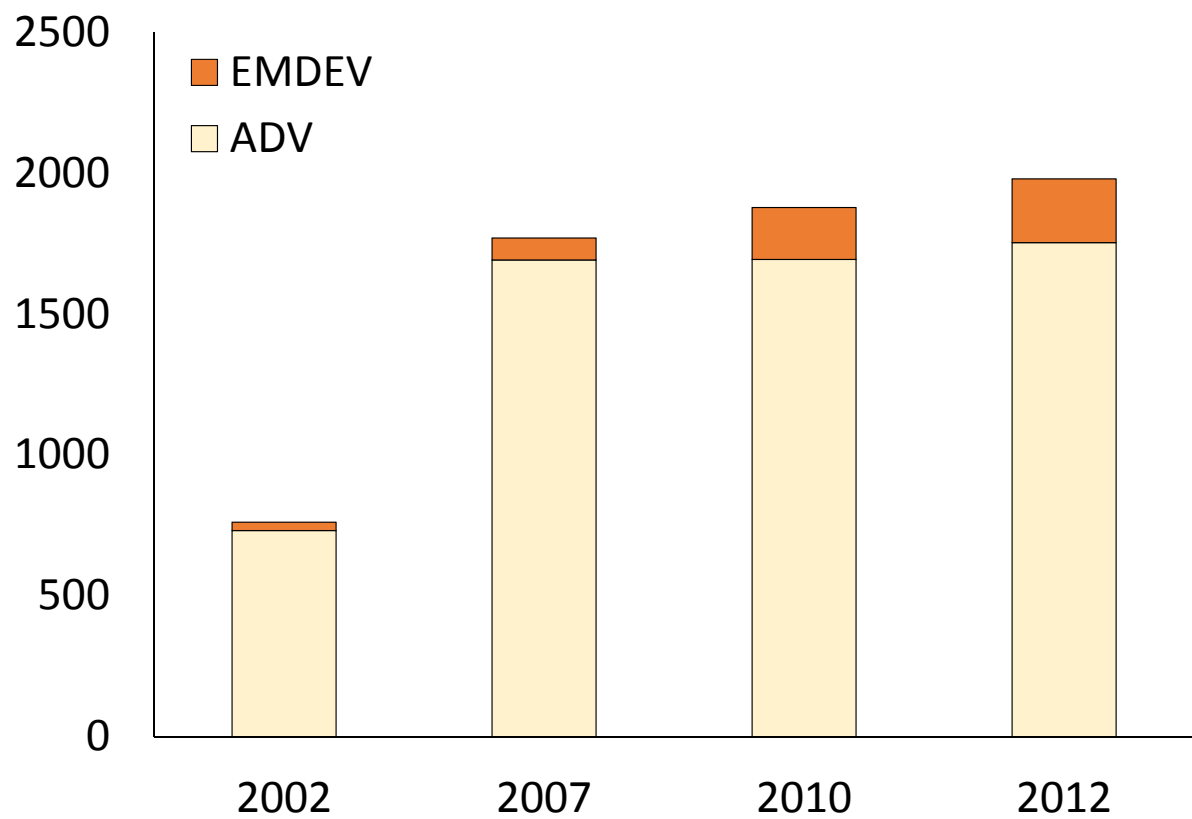


Figure 2: Exposures to Swiss Franc (Average 2002-2012)



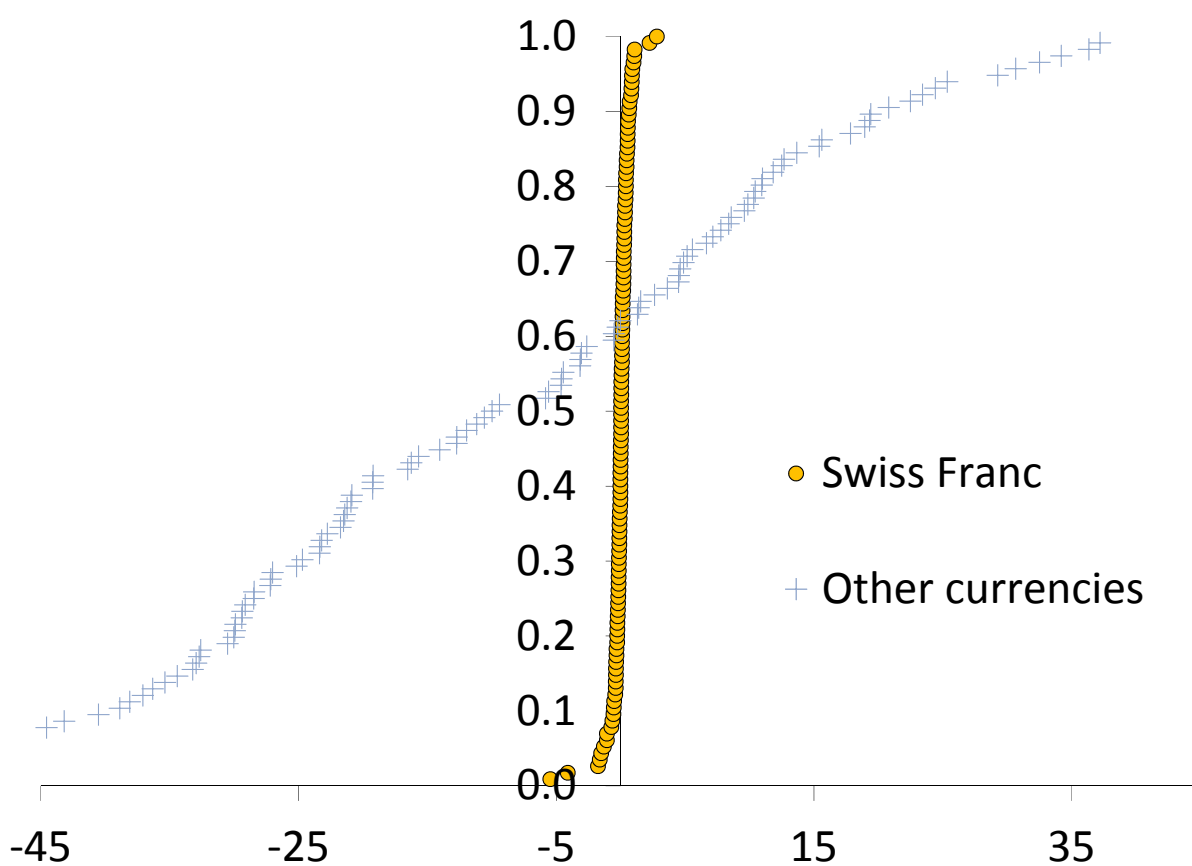
**Note:** Currency exposures are the average of  $FXAGG^{CHF}$  for the 2002-2012 period.

Figure 3: Foreign Assets Denominated in Swiss Franc



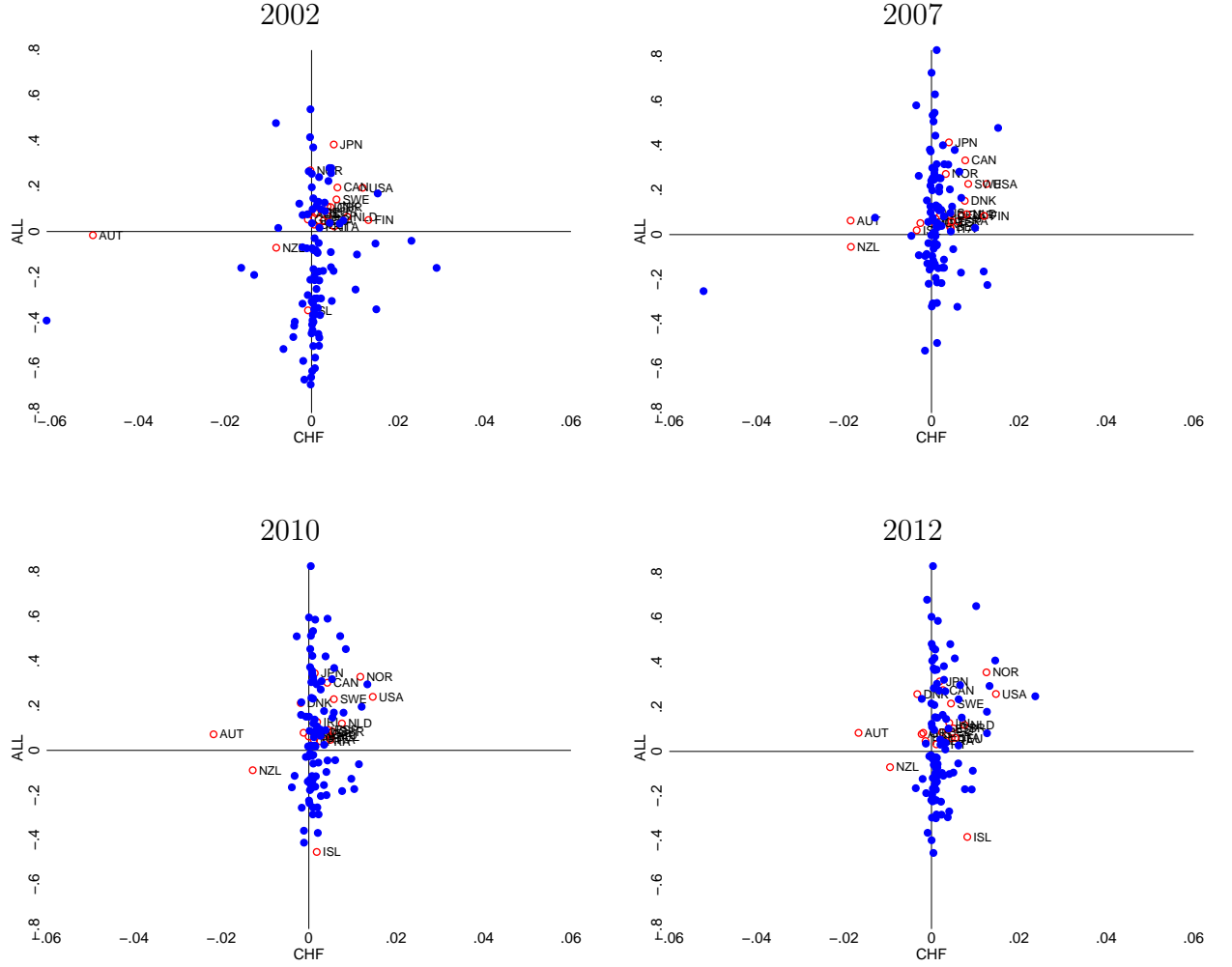
**Note:** Billion of US dollars. Estimates based on 116 countries.

Figure 4: Exposures to Swiss Franc and other currencies (Average 2002-2012)



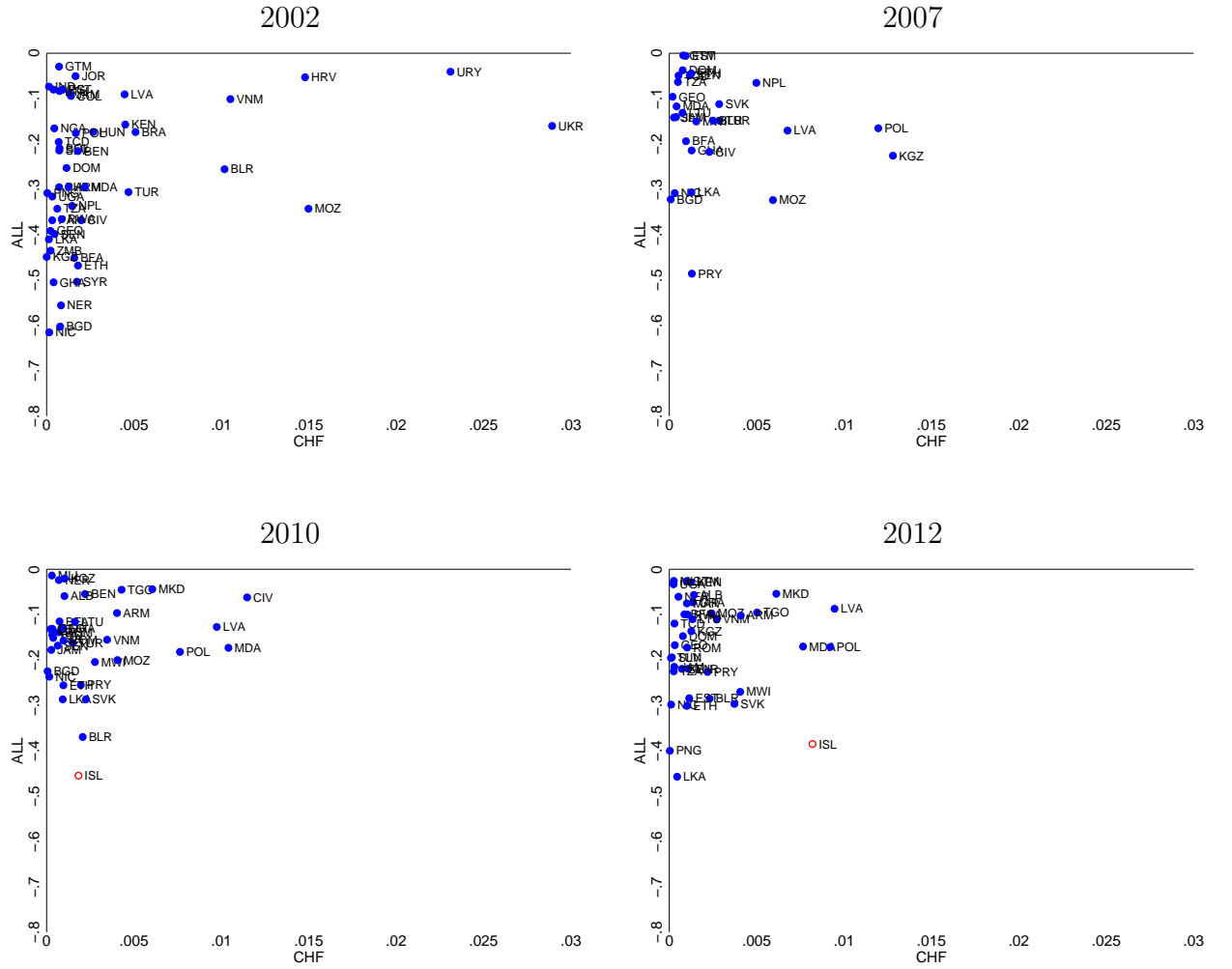
**Note:** Currency exposures are the average of  $FXAGG$  for the 2002-2012 period. These distributions are based on 116 countries.

Figure 5: Swiss Franc Exposure vs. Overall Exposure



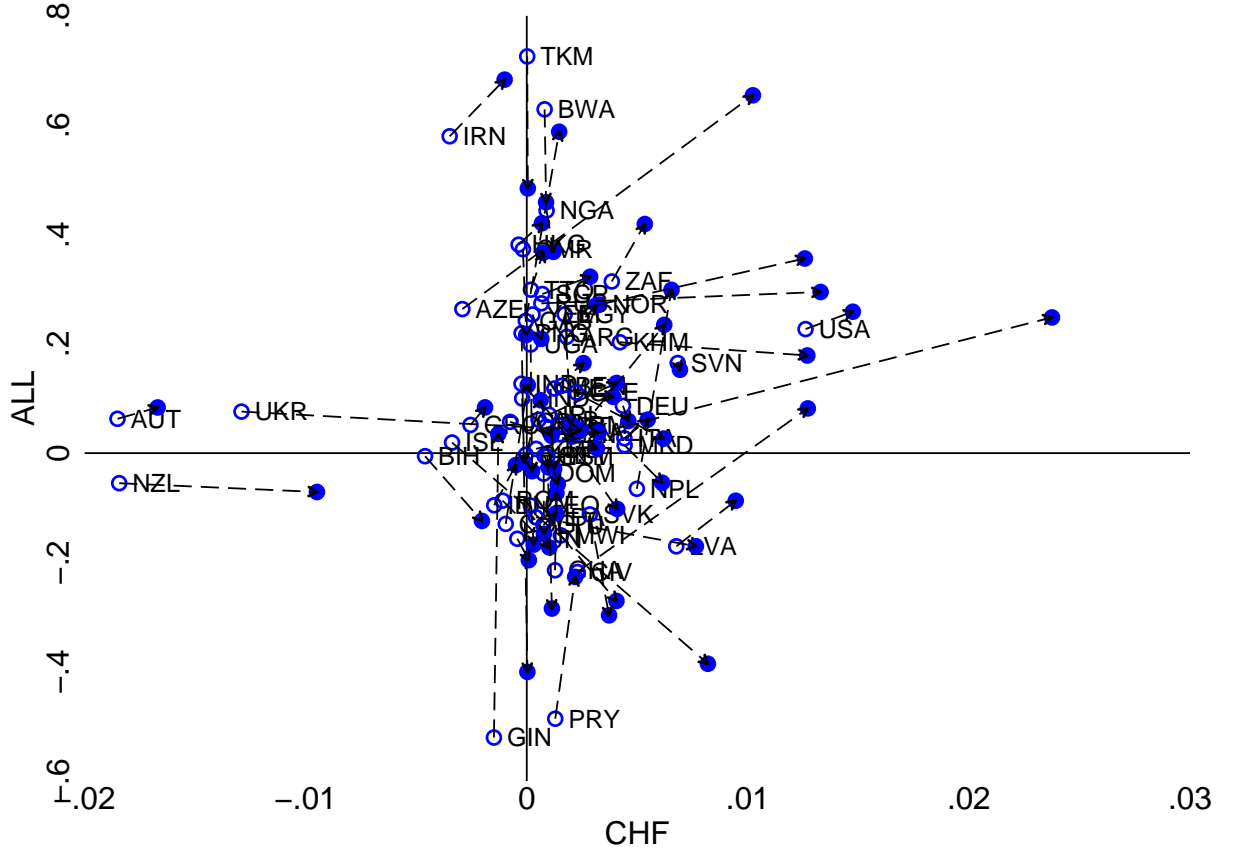
**Note:**  $CHF$  are cross-country exposures to Swiss Francs ( $FXAGG^{CHF}$ ) while  $ALL$  are aggregate exposures to other foreign currencies ( $FXAGG^{OTH}$ ). The correlation coefficient of these variables is positive for in 2002 and 2007 with values of 0.13 and 0.14, respectively. These correlations are negative in 2010 and 2012 with values of -0.01 and -0.002, respectively. Hollowed red circles are advanced countries while filled circles are emerging and developing countries.

captionSwiss Franc Exposure vs. Overall Exposure



**Note:** Countries long Swiss Franc but short in the rest of foreign currencies.  $CHF$  are cross-country exposures to Swiss Francs ( $FXAGG^{CHF}$ ) while  $ALL$  are aggregate exposures to other foreign currencies ( $FXAGG^{OTH}$ ). Hollowed red circles are advanced countries while filled circles are emerging and developing countries.

Figure 6: Dynamics of Currency Exposures (2007,2012)



**Note:** Countries with more positive (or less negative) Swiss Franc position after the crisis. *CHF* are cross-country exposures to Swiss Francs ( $FXAGG^{CHF}$ ) while *ALL* are aggregate exposures to other foreign currencies ( $FXAGG^{OTH}$ ). Hollowed circles are exposures in 2007 while filled circles represent exposures in 2012. Dashed vectors indicate the direction of the change in these exposures.