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# On the roles of different foreign currencies in European bank lending

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# On the roles of different foreign currencies in European bank lending

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## Abstract

We draw on a new data set on the use of Swiss francs and other currencies by European banks to assess the patterns of foreign currency bank lending. We show that the patterns differ sharply across foreign currencies. The Swiss franc is used predominantly for lending to residents, especially households. It is sensitive to the interest rate differential, exchange rate developments, funding availability, and to some extent international trade. Domestic lending in other currencies is used, to a greater extent, in cross-border lending, and for lending to resident nonfinancial firms, and is much less sensitive to the drivers identified for Swiss franc lending. Policy measures aimed at foreign currency lending have a clear impact on lending to residents. The results underline that not all foreign currencies are alike when it comes to foreign currency bank lending and the associated financial stability risks.

*JEL Classification:* F32, F34, F36.

*Keywords:* Swiss franc lending, foreign currency lending, cross-border transmission of shocks, European bank balance sheets.

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# 1 Introduction

Prior to the crisis, banks in emerging Europe increased the share of their business in foreign currencies. As an example, 39 percent of the assets of Hungarian banks and 40 percent of their liabilities were denominated in foreign currencies in 2007. By 2009 these shares had risen to 52 and 54 percent, respectively. The global crisis then led to a reassessment of banks international activities across borders and in foreign currencies, and by the end of 2014 the shares of Hungarian banks assets and liabilities that were not in forint had fallen back to 36 and 32 percent.

Bank lending in foreign currencies is of concern to policy makers as it may disrupt financial stability. Household mortgages in foreign currencies is a case in point. While these can have the appeal of low interest rates, they leave households exposed to the fluctuations of exchange rates, which are not always understood by the borrower *ex ante*. Unexpected appreciations can lead to sharp increases in monthly payments, and the associated deterioration in borrowers financial situation can in turn weaken the banking sector and systemic concerns (Yesin [2013]). A large literature examines the issue of foreign currency activity of banks to better understand the drivers of banks' use of foreign currencies in lending and the associated risks. The literature shows that banks' activities in foreign currencies can bring benefits that need to be weighted against the cost of exchange rate exposure. This balancing exercise is complex, and takes place in the context of the globalized nature of the banking industry, which by itself makes banks a potent channel of international transmission of economic fluctuations (Cetorelli and Goldberg [2011]). The previous literature, however, focuses on contrasting foreign currency use with local currency use, but treats all foreign currencies alike, as homogeneous. In this paper, we contribute to this literature by broadening the scope of investigated foreign currencies. Drawing on a new dataset on banks' balance sheet in different currencies, we show that banks' lending in Swiss francs takes different forms, and is impacted by different factors, than lending in other foreign currencies. That different foreign currencies have different implications for lending dynamics and financial stability may matter for how to best approach the design of policies to counter the associated risks.

Our analysis is based on the Swiss franc lending monitor, a novel dataset collected by the Swiss National Bank in cooperation with other European central banks. It provides information of the currency composition of the banking sector's balance sheet for a broad range of European countries. The stylized facts on bank lending in the different currencies suggest substantial heterogeneity across currencies. In particular, the Swiss franc is used primarily for lending to local households, while other foreign currency lending is to a higher degree used for lending to non-financial companies and cross border lending. Moreover, and in line with findings in Yesin [2013] based on the same dataset, we confirm that banks only partially offset their on-balance sheet Swiss franc position through liabilities denominated in Swiss francs. In contrast, other foreign currency lending is associated with much less balance

sheet currency mismatch.

We further undertake an econometric analysis to assess which macroeconomic variables drive bank lending in the different currencies, and document a substantial extent of heterogeneity across country groups as well as across currencies. Specifically, Swiss franc lending to domestic residents is sensitive to funding costs, exchange rate developments, funding availability, and (to some extent) international trade flows. Lending in other foreign currencies shows much less sensitivity to these variables. The results thus suggest that lumping all foreign currency lending together when assessing the drivers of this lending may mask important cross currency heterogeneity in these drivers. We also find that policy measures aimed at curbing lending in specific currencies matter, and base this finding on the specific restrictions on Swiss franc lending adopted by Hungary in late 2011 and early 2012. These reduced lending in Swiss francs to residents. The effects were partially offset through higher lending in euros, however, suggesting that macroprudential measures targeting the use of specific currencies considered risky may have the effect of migrating the risk to other currencies.

The rest of the paper is structured as follows. Section 2 reviews the related literature. Section 3 presents the Swiss lending monitor data and some major stylized facts. The econometric analysis is undertaken in section 4, which presents the explanatory variables and the regression findings. Section 5 concludes and the appendix describes the data.

## 2 Related Literature

Our work ties to several broad streams of literature. The first is the study of foreign currency lending and deposits. Contributions have focused on the drivers of foreign currency lending. For instance, Brown and Haas [2012] consider the role of foreign banks in issuing foreign currency lending. One of their findings is a link between the two sides of the balance sheet, as that movements in foreign currency deposits are transmitted to foreign currency lending. Other papers consider banks' liabilities. Brown and Stix [2014] focus on households' deposits and shows a connection with macroeconomic volatility and households' experiences of a past currency crisis. Their work however does not consider the determinants of other funding sources such as interbank loans. This line of research contrasts the positions in foreign and local currencies, but does not consider any heterogeneity across different foreign currencies.

Several contributions focus on lending specifically denominated in Swiss francs. Brown et al. [2009] document substantial heterogeneity in the nature of Swiss franc loans across countries. Yesin [2013] relies on the same dataset as we to illustrate and analyze the prevalent mismatch between assets and liabilities denominated in Swiss francs on European bank balance sheets. Auer et al. [2012] focus on the refinancing of Swiss franc lending by Austrian banks. They show a clear break during the crisis when funding through the unsecured interbank market and bond issuance was replaced by funding through the repo market and reliance on liquidity provision by central banks.

The second stream of the literature to which our work is related is the international transmission of shocks through the activity of global banks, with several papers stressing their central role in the crisis (Takats [2010], Avdjiev et al. [2012], McCauley et al. [2015], Milesi-Ferretti and Tille [2011]). Cetorelli and Goldberg [2011] document the spreading of shocks through cross-border lending and operations of local affiliates. Cetorelli and Goldberg [2012] stress the relevance of banks' internal capital markets as affiliates in more robust countries can be used as sources of funds for the parent in a crisis. Cerutti et al. [2014] assess the determinants of cross-border bank lending in a broad sample of countries. It finds that the term premium in core economies matters, which captures the incentive for banks to search for yield. Funding conditions of banks also play a role. Bruno and Shin [2014] find that the global leveraging cycle in the banking sector is a prominent driver of international bank capital flows. None of these contributions compare and identify differences across foreign currencies.

Our work is also related to the literature on what drives non-bank actors to issue liabilities in foreign currencies. Avdjiev et al. [2014] show the growing propensity by corporates in emerging markets to issue debt in foreign countries. In addition to standard carry-trade considerations, this reflects the ability of these firms to get around restrictions on capital mobility (Caballero et al. [2015]). Hale and Spiegel [2012] show that the reduction in transaction costs brought on by the euro led to a switch of corporate borrowing towards the euro. McBrady and Schill [2007] find that the currency composition of borrowing by entities with no hedging needs reflects the relative costs, proxied by deviations from covered and uncovered interest parity.

A final stream of literature is the study of the consequences of currency mismatch on the international transmission of shocks. This mismatch magnifies the adverse consequences of sudden reversals in capital flows (Reinhart and Calvo [2000], Choi and Cook [2004]), for instance leading to larger movements in international relative prices (Calvo et al. [2006]). Private agents fail to take full account of this magnifying effect when incurring foreign liabilities, leading to an inefficient amplification of the boom-bust cycle (Jeanne and Korinek [2013], Mendoza [2010]).

## **3 Data and Stylized Facts**

### **3.1 The Swiss Franc Lending Monitor**

Following Yesin [2013], we rely on the Swiss franc lending monitor, a database maintained by the Swiss National Bank using inputs from 20 participating central banks. Its purpose is to provide information on the role of the Swiss franc in bank lending and funding across a broad range of European countries. The data consist of quarterly observations on various components of banks' balance sheet positions starting at the latest in the first quarter of

2009. As data start earlier for some of the sample countries, we use an unbalanced sample that starts in the first quarter of 2007 for our regressions.<sup>1</sup> This allows us to cover at least a small part of the pre-financial crisis period as well. We present the stylized facts from 2009 only, to ensure comparability across countries.

We include 17 of the 20 European countries in our sample.<sup>2</sup> The balance sheet items are reported at the aggregate country level for all resident banks, including subsidiaries of foreign banks but not foreign bank branches. The inclusion of subsidiaries of foreign banks is important as they account for a very large market share, particularly in some Eastern European countries.

Importantly for our purposes, the data provide a breakdown of balance sheet positions across currencies.<sup>3</sup> Specifically, all positions are divided between Swiss francs, all other foreign currencies, and the domestic currency. This provides exceptionally detailed information on balance sheet positions in the Swiss franc. While other foreign currency positions are not broken down into individual currencies, we can estimate a breakdown across currencies based on information from other sources. We find that the U.S. dollar dominates the non-Swiss franc foreign currency positions in euro countries and advanced economies, and the euro dominates the non-Swiss franc foreign currency position in the non-euro countries. There are, in addition, smaller positions in yen and pounds in both country groups.

The data divide bank asset positions between lending and other assets, while liability positions are divided between deposits (including repo and interbank borrowing), own securities issuance and other liabilities. Lending and deposits are further divided on counterparty types, including resident households, resident non-financial corporations, resident banks (domestic interbank), government, non-resident banks and non-resident non-banks.<sup>4</sup> Our focus is on lending from the domestic banking sector to the rest of the economy, so we exclude domestic interbank positions. As the breakdown between households, non-financial corporations and government is incomplete for many of the countries, we focus on the split between total domestic non-bank, foreign bank and foreign non-bank positions.<sup>5</sup>

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<sup>1</sup>The individual country charts in Appendix reflect the period covered for each country.

<sup>2</sup>Austria, Bulgaria, Czech Republic, Croatia, Denmark, Estonia (Estonia is included twice, with the pre-2011 sample included as a non-euro countries and the post-2011 sample included as a euro country), France, Germany, Greece, Hungary, Latvia, Luxembourg, Romania, Serbia, Slovenia, Slovakia, and the United Kingdom. Three countries, Italy, Poland and Iceland, are included in the data base, but not in our study. Italy is only included in some of the stylized facts looking at country averages, as the time variation in the data seems implausible and suggests data errors. Moreover, Poland is only included on the funding side, as Poland's data coverage of foreign lending and other assets is incomplete. Iceland is not included due to insufficient data coverage.

<sup>3</sup>An advantage of using this data set over the BIS locational banking statistics for currency breakdown is that it includes more European countries than the BIS reporting countries. It hence allows us to make more detailed analysis of developments in foreign currency positions of European bank balance sheet.

<sup>4</sup>The data unfortunately does not divide positions with foreign bank counterparties on positions vis-a-vis a foreign parent bank and positions vis-a-vis an unrelated foreign bank.

<sup>5</sup>For the countries that do provide this split, the share of Swiss franc loans to domestic government is very small. We can hence consider non-bank lending to be lending to private non-bank residents.

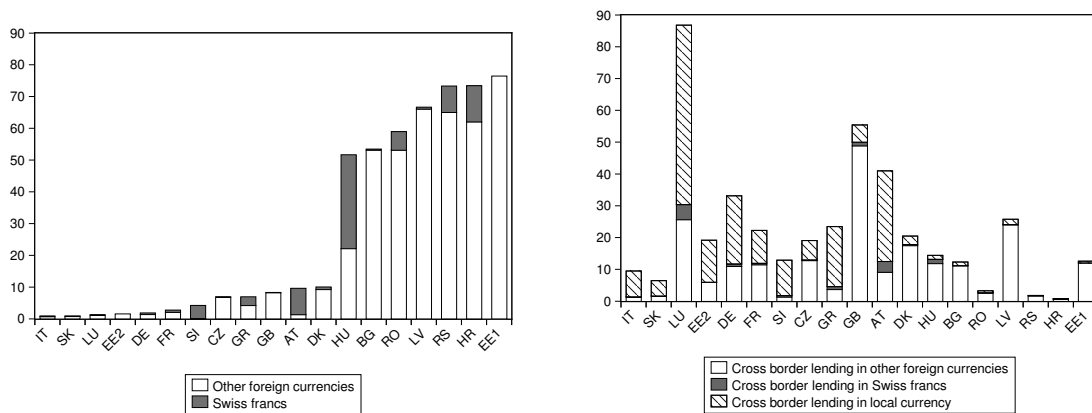
### 3.2 Stylized facts

This section presents the main stylized facts for the different roles played by the Swiss franc and by other foreign currencies in foreign currency lending. We contrast across sub-groups of European countries when this is informative.

These stylized facts shows that not all foreign currencies are alike, as the patterns for Swiss franc lending differ substantially from the pattern for other foreign currencies. This is observed in terms of the prevalence of domestic vs. cross-border lending, the counterparties, the evolution through time, and the funding of foreign currency lending positions.

#### 3.2.1 Extent of lending in foreign currency

We first illustrate the relevance of foreign currency lending to non-bank residents. The left panel of Figure 1 shows the shares of total bank lending that go to domestic non-bank residents and are denominated in foreign currency. This form of lending accounts for a large share of bank lending in emerging Europe. In contrast, it plays a much smaller role in countries in the euro area and financial centers. While the euro and U.S. dollar play a dominant role, the Swiss franc also matters. It has been the dominant foreign currency for domestic lending in Austria, Hungary and Slovenia, and important in Greece, Romania, Serbia and Croatia on the average for the sample period that we are considering.



(a) Foreign currency domestic lending to non-banks

(b) Total cross border lending

Figure 1: **Foreign currency lending in percent of total lending.**

Excluding domestic interbank lending. The charts are constructed such that if the bars of the two charts are summed for each country, the remaining share of to 100 percent reflects domestic non-bank lending in domestic currency. Averages across the quarters 2009Q1 to 2014Q4. EE1 refers to Estonia prior to Q1 2011, and EE2 refers to Estonia after Q1 2011. Both figures are sorted according to the share of foreign currency domestic non-bank lending in total non-bank lending. Source: SNB.

Foreign currencies play a different role in cross border lending (right panel of Figure 1). They account for a small share of such lending in emerging Europe, but a large share in advanced economies, especially financial centers. The Swiss franc plays only a marginal

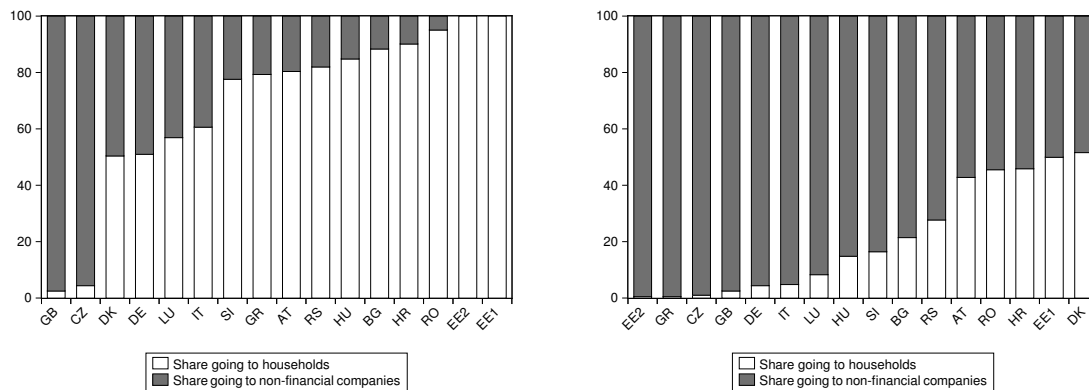


role in such cross-border lending. Austria, Graet Britain, Greece, Hungary and Luxembourg are the only countries with non-negligible Swiss franc lending to foreign residents, a pattern that likely reflects these countries' roles in distributing Swiss franc funding to the remaining countries in the sample.

### **3.2.2 Counterparties of lending in foreign currency**

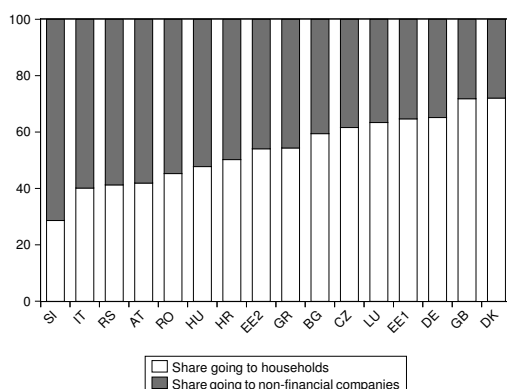
We next turn to the counterparties to whom banks lend in foreign currencies. Figure 2 splits the lending to domestic non-bank residents between households and non-financial companies, for loans in Swiss franc (panel (a)), other foreign currencies (panel (b)), and domestic currency (panel (c)), for the countries that provide such a split. The Swiss franc is predominantly used for lending to domestic households, reflecting the popularity of the Swiss franc for denominating retail mortgages. Other foreign currencies are predominantly used for lending to non-financial companies, which is likely to reflect a high share of trade and investment credits for exporting and importing firms, mainly in euros and U.S. dollars. Finally, loans in local currency are more balanced between households and firms.

Figure 3 shows the split of cross-border lending between loans to foreign banks and foreign non-bank counterparties for the Swiss franc, other foreign currencies, and the local currency of the lending country. We observe that foreign banks are the dominant counterparty for most countries, and that this pattern is quite even across the various currencies. While loans to non-banks account for a large and even dominant share for some countries, it is important to note that overall cross-border lending is relatively small for these countries.



(a) Swiss franc domestic lending

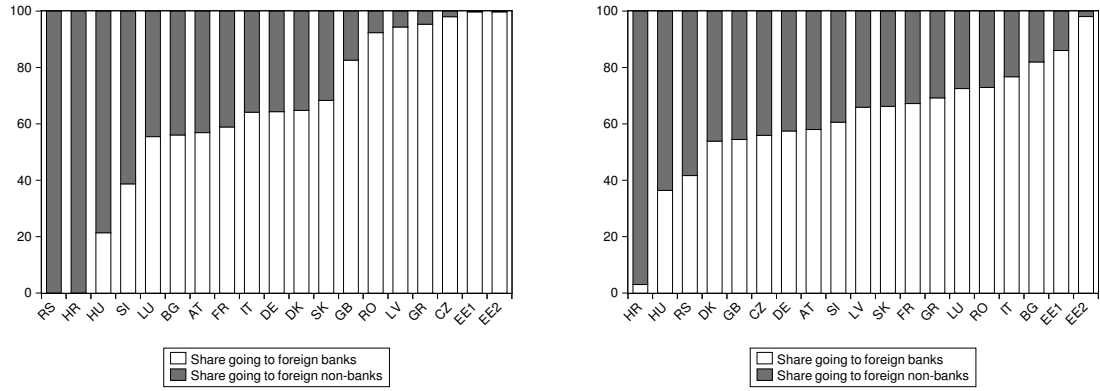
(b) Domestic lending in other foreign currencies



(c) Domestic lending in domestic currency

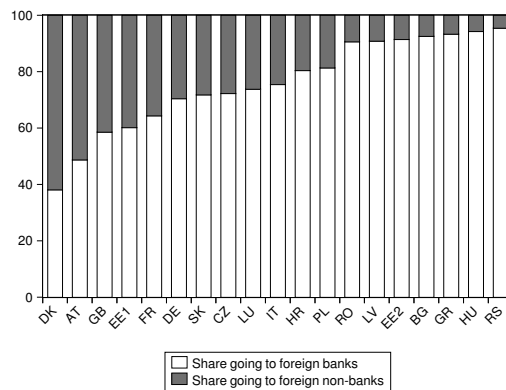
**Figure 2: Foreign currency domestic lending: Sectoral shares**

The data exclude domestic interbank lending. Averages across the quarters 2009Q1 to 2014Q4. France and Slovakia are excluded due to lack of data. Moreover, Latvia is excluded in the Swiss franc figure as it only provides the sectoral breakdown for other foreign currencies. EE1 refers to Estonia prior to Q1 2011, and EE2 refers to Estonia after Q1 2011. Both figures are sorted according to the share of Swiss franc lending to resident households. Source: SNB.



(a) Swiss franc cross border lending

(b) Cross border lending in other foreign currencies



(c) Cross border lending in domestic currency

**Figure 3: Foreign currency cross border lending: Sectoral shares**

Averages across the quarters 2009Q1 to 2014Q4. EE1 refers to Estonia prior to Q1 2011, and EE2 refers to Estonia after Q1 2011. Both figures are sorted according to the share of Swiss franc lending to domestic households. Source: SNB.

### 3.2.3 Evolution of lending through time

We now turn to the evolution of foreign currency lending through time. The shares of the various currencies present a substantial extent of heterogeneity.<sup>6</sup> We summarize the pattern by running panel regressions for the shares of the various currencies on time and country fixed effects. In addition to running these regression for the overall sample, we also run them for the sample of euro area countries, and the sample of other countries.<sup>7</sup> The estimated time fixed effects provide us with a summary measure of the development over time within each subgroup.

The time fixed effects for the shares of the Swiss franc and other foreign currencies in domestic lending are presented in Figure 4 (panel (a) and (b) respectively). The share of Swiss franc lending has since been on a steady downwards trend since the financial crisis, especially in countries that are not members of the euro area. Closer inspection of the data shows that this trend has been most pronounced in the non-euro European countries which have not been pegging to the euro during the sample period. By contrast, the share of other foreign currencies have been much more volatile, and do not exhibit a particular downward trend.

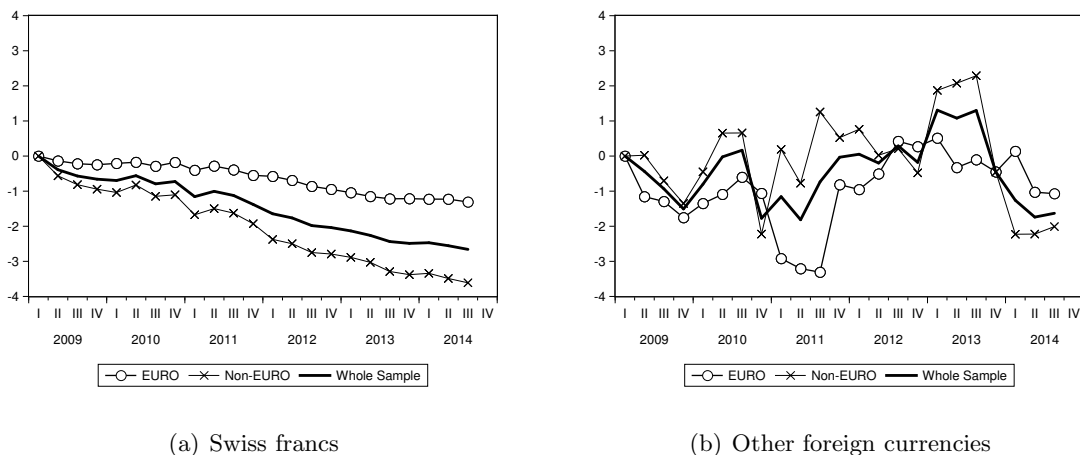


Figure 4: **Time factor in foreign currency shares of domestic lending**

Quarterly, 2009Q1 to 2014Q4. The data depicts the value of the time fixed effects estimated in panel regressions of the share of lending to domestic residents in the respective foreign currency on time and cross sectional fixed effects, for the respective subsample of countries. Time fixed effects are set to zero in 2009Q1. Source: own estimations.

Figure 5 shows the results of a similar exercise for lending across borders. We observe a similar pattern of reduction in the Swiss franc share since the crisis, with no such decrease in the share of other currencies.

<sup>6</sup>The Appendix provides figures for individual countries on the changes over time in the share of domestic lending that is denominated in Swiss francs and in other foreign currencies respectively

<sup>7</sup>We have additionally run these regressions for samples that split euro as well as non-euro countries further into financial centers and periphery, and pegging and non-pegging non-euro countries. Results are available upon request.

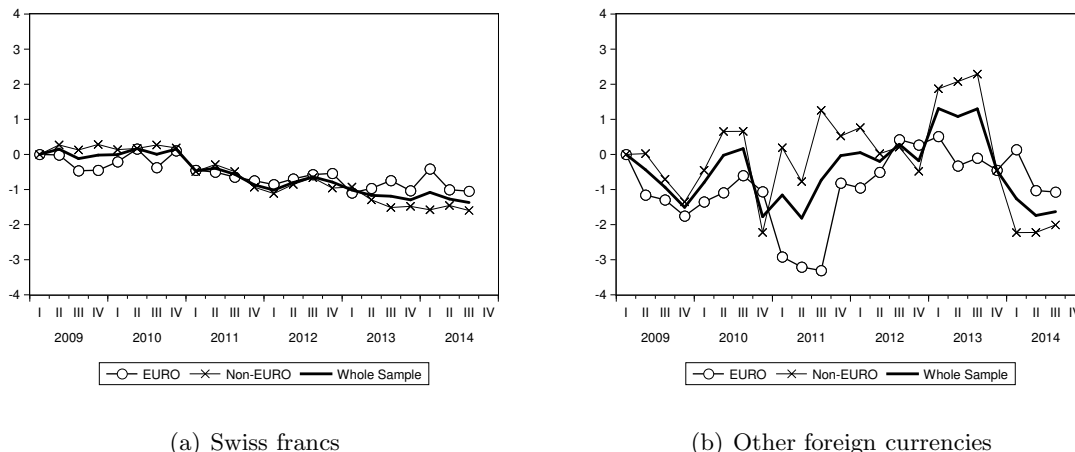


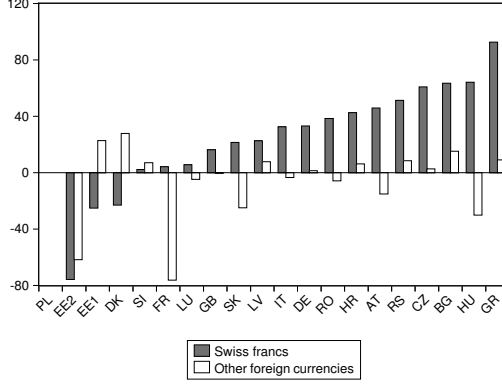
Figure 5: **Time factor in foreign currency shares of cross border lending**

Quarterly, 2009Q1 to 2014Q4. The data depicts the value of the time fixed effects estimated in panel regressions of the share of lending to foreign residents in the respective foreign currency on time and cross sectional fixed effects, for the respective subsample of countries. Time fixed effects are set to zero in 2009Q1. Source: own estimations.

### 3.2.4 Funding of foreign currency lending

Our final stylized fact focuses on the mismatch between assets and liabilities in specific currencies. Anecdotal evidence suggests that banks have a variety of different funding models for foreign currency lending. Residential mortgage loans in foreign currency are typically extended in local currency, but indexed to the Swiss franc exchange rate, and subject to the Swiss franc interest rate. Such loans typically do not require initial foreign currency funding, but will give rise to a currency exposure by the extending bank, in turn giving rise to a need for hedging. Other foreign currency loans are by contrast extended in Swiss francs directly, when the borrower actually needs Swiss franc liquidity. Such loans will give rise to an initial funding need by the extending bank.

Figure 6 shows that a large share of banks' Swiss franc assets are not funded on balance sheet, giving banks a net long position in Swiss francs. The situation is very different for other foreign currencies where a larger share of loans is funded in the same currency. As a result, the net positions are much smaller in these currencies for the vast majority of countries. This pattern of net exposure was first documented by Yesin [2013]. This on-balance sheet mismatch may reflect the high share of Swiss franc loans going to domestic resident households, and possibly a different use of off-balance sheet hedging for such lending. In Krogstrup and Tille [2016], we take a closer look at what drives European banks' funding needs in different currencies.



(a) Swiss francs

Figure 6: **Balance sheet currency mismatch across countries**

Averages across the quarters 2009Q1 to 2014Q4 for foreign currency assets in excess of foreign currency liabilities, in percent of foreign currency assets. The number reflects the percent of foreign currency assets that are not funded on balance sheet. EE1 refers to Estonia prior to Q1 2011, and EE2 refers to Estonia after Q1 2011. The figure is sorted according Swiss franc balance sheet mismatch. Source: SNB.

## 4 Econometric Analysis of Foreign Currency Lending

### 4.1 Measures of financial flows

The domestic currency value of banks' lending positions denominated in foreign currencies can change for two reasons. First, exchange rate movements directly affect the value, with an appreciation of the foreign currency raising the value of a foreign currency loans expressed in domestic currency. We are not interested in such valuation effects, and instead focus on the second reason, namely net new extension of loans in the currency of denomination. To measure net new extension of loans, we adjust the data from the lending monitor to filter out the direct valuation impact of exchange rate movements.

Consider the lending position of country  $c$  in a foreign currency  $j$ . We denote its value in domestic currency at the end of period  $t$  by  $L_t^{c,j}$ . We denote the exchange rate in terms of units of local currency per unit of foreign currency as  $S_t^{c,j}$  (so an increase is an appreciation of the foreign currency). The total change in the value of the position between periods  $t-1$  and  $t$  consists of the capital flows  $F_t^{c,j}$  and the valuation impact of the exchange rate:

$$L_t^{c,j} = L_{t-1}^{c,j} + F_t^{c,j} + \frac{dS_t^{c,j}}{S_{t-1}^{c,j}} L_{t-1}^{c,j}$$

Which we rewrite as:

$$i_t^{c,j} = f_t^{c,j} + \dot{S}_t^{c,j}$$

where  $i_t^{c,j} = dL_t^{c,j}/L_{t-1}^{c,j}$ ,  $f_t^{c,j} = F_t^{c,j}/L_{t-1}^{c,j}$  and  $\dot{S}_t^{c,j} = dS_t^{c,j}/S_{t-1}^{c,j}$ . There is one such relation

for positions in CHF and one for positions in other foreign currencies. While the Swiss franc lending monitor does not provide the breakdown over the various currencies, data from other sources show a dominant role of the euro for emerging European economies and the U.S. dollar for the other countries.<sup>8</sup> We thus assume that the positions in other foreign currencies are denominated in one of these two currencies, depending on the countries group we consider.

## 4.2 Explanatory variables

We assess the drivers of lending flows by regressing  $f_t^{c,CHF}$  and  $f_t^{c,otherFX}$  on a range of variables capturing domestic and global conditions.

The first set of variables control for the characteristics of the domestic economy. Macroeconomic conditions are proxied by the domestic real GDP growth and CPI inflation. As financial activity in foreign currencies is driven in part by international trade transactions, we control for trade openness through the growth rate of total trade flows (exports plus imports).<sup>9</sup> We also include the change in lending in domestic currency to capture whether the country is experiencing an overall credit boom, as opposed to changes in lending that are heterogeneous across currencies.

The second set of variables reflects funding costs in the various currencies. We proxy them by the spread between the money market interest rate in the local currency and the interest rate in the Swiss franc (respectively euro, and U.S. dollar). A higher value indicates that funding in the domestic currency is relatively expensive.

We next include the changes in the liability positions denominated in foreign currencies (adjusted for the valuation effect of exchange rates) to see whether an increase in foreign currency deposits or wholesale funding subsequently fuels lending in foreign currencies.

The fourth set of variables reflect exchange rate movements. We include the percent appreciation of the Swiss franc (respectively euro, and U.S. dollar) vis--vis the domestic currency. We also consider the volatility of exchange rate movements, which we compute as the intra-quarter variance at a weekly frequency.

The fifth set of variables reflects the provision of liquidity by central banks in the major currencies. We proxy it by the change in the ratio of monetary base to GDP.

Finally, we include the change in the VIX index to capture any impact of global risk perceptions. We control for the fact that in mid-2013 the Swiss monetary base increased as the financial service department of the postal administration was reclassified as a bank.

The descriptive statistics for all dependent and explanatory variables are listed in Table

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<sup>8</sup>Specifically, we rely on three sources. The first is the ECB annual report on the international role of the euro (the latest of which is ECB [2014]). The second is information gathered from the web-sites of the national central banks. The third is a regression analysis, where we assume that exchange rate movements immediately affect the local currency value of the positions denominated in foreign currencies, but affect outright flows only with a lag.

<sup>9</sup>Trade flows are taken in nominal terms, as financing needs by trading firms are driven by their nominal transactions.

1. All variables are defined in relative changes (i.e. not percentages).

We also strive to control for the regulations that some countries enacted to restrict the use of foreign currency loans out of concerns for financial stability purposes (IMF [2015]). Note that our specification in first-difference indirectly controls for cross-country differences in regulation that remained unchanged through time. Our focus is then on intra-country changes in regulation during our sample. Controlling for such changes, which likely played a significant role, is challenging as we lack a unified source of information.<sup>10</sup> A specific case is Hungary, which has taken the widest ranging measures in our sample. Specifically, the Hungarian government introduced special repayment schemes and conditions for foreign currency mortgages that strongly reduced their outstanding volume in the last quarter of 2011 and first quarter of 2012 (IMF [2013] box 2).<sup>11</sup> We assess the effect of these measures by including dummies for 2011Q4 and 2012Q1 for Hungary.

	Mean	Maximum	Minimum	Std. Dev.	No. Obs
dlog(domestic lending CHF)	-0.011	1.063	-0.568	0.138	458
dlog(domestic lending OC)	0.004	0.605	-0.933	0.105	458
dlog(cross border lending CHF)	0.090	10.967	-0.925	0.759	458
dlog(cross border lending OC)	0.028	2.147	-0.715	0.215	458
growth	0.007	0.127	-0.172	0.046	533
inflation	0.031	0.162	-0.032	0.029	574
dlog(gross trade)	0.009	0.234	-0.351	0.076	519
dlog(lending in dom. currency)	0.012	2.285	-0.151	0.114	443
$\dot{i}_{domestic} - \dot{i}_{CHF}$	0.026	0.177	0.000	0.032	544
$\dot{i}_{domestic} - \dot{i}_{USD}$	0.018	0.162	-0.032	0.032	544
$\dot{i}_{domestic} - \dot{i}_{EUR}$	0.015	0.159	-0.029	0.031	544
dlog(funding CHF)	0.025	3.221	-0.854	0.311	458
dlog(funding OC)	0.006	0.387	-0.428	0.074	458
CHF appreciation	0.011	0.170	-0.080	0.033	544
USD appreciation	0.003	0.238	-0.096	0.050	544
EUR appreciation	0.002	0.112	-0.051	0.018	544
CHF volatility	0.028	1.428	0.000	0.075	544
USD volatility	0.035	0.395	0.004	0.038	544
EUR volatility	0.006	0.193	0.000	0.017	544
d(Swiss M0/GDP)	0.018	0.165	-0.036	0.049	510
d(US M0/GDP)	0.005	0.038	-0.006	0.009	527
d(EU M0/GDP)	0.001	0.025	-0.021	0.011	510
d(VIX)	0.000	0.033	-0.014	0.008	544

Table 1: Descriptive Statistics

$fundingOC$  ( $CHF$ ) is funding in other foreign currencies (Swiss francs). Source: SNB.

As our database comprises a highly heterogeneous sample of countries, we undertake separate regressions for each of four groups. The first group includes the countries in emerging Europe, for which we take the euro to be the main foreign currency other than the Swiss franc.

<sup>10</sup>Even with that information, attributing values to the various changes in order to quantify their impact would be difficult and beyond the scope of this paper

<sup>11</sup>In the last quarter of 2014, Hungary again enacted wide ranging regulations that required the forced conversion of large parts of its remaining outstanding foreign currency loans to domestic currency denomination. This measure however fall out of our sample.



The second group regroups advanced economies that are not members of the euro area. The third group includes countries in the periphery of the euro area and the final group consists of core euro area countries.<sup>12</sup> For the last three groups, we take the U.S. dollar to be the foreign currency other than the Swiss franc.

### 4.3 Interpretations of results: demand and supply factors

A study like ours faces two challenges for interpretation that are standard in the literature. The first is the issue of reverse causality, as the dependent variable could cause the independent ones. For instance, higher lending may boost GDP growth, or lead to inflationary pressures. We address this issue in a standard (albeit imperfect) way by lagging the explanatory variables.<sup>13</sup>

A second, and more challenging, issue is to interpret the results in terms of demand and supply factors. Higher lending volumes could reflect a supply push by foreign or local banks as they attempt to invest additional funds, or a demand pull by borrowers who may want to fund projects with improved prospects. A standard approach is to jointly analyze quantities and prices to disentangle demand and supply factor, but we lack the pricing data to do so.

Instead, we can contrast the various drivers in terms of their likelihood of reflecting supply or demand factors. Domestic growth and changes in trade flows are more likely to reflect demand factors as a booming economy offers better return prospects in investment projects. The spread across money market rates in foreign and domestic currencies can be interpreted as supply factors, as the interest rates in USD, CHF and euro are not affected by the conditions in the domestic country.<sup>14</sup> Changes in the funding volumes in Swiss francs and other foreign currencies (in terms of the component are orthogonal to other explanatory variables) are unlikely to be driven by the demand from borrowers, and thus can be interpreted as supply factors.

Developments in exchange rates, both in terms of levels and volatility, are harder to interpret. Borrowing in an appreciating currency is of limited appeal for the lender, as it raises the ultimate debt burden. While it should be more interesting for the lender, a bank undergoing a careful risk assessment would rightly perceive a foreign currency loan as putting more pressure on the borrower and thus entailing a larger risk of default.

Changes in the monetary base in Switzerland, the euro area, and the United States can clearly be interpreted as supply factors as they are not affected by the situation in the domestic economy. Similarly, movements in the VIX index are supply factors as they reflect the situation in financial markets in advanced economies overall.

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<sup>12</sup>The specific countries are as follows. Bulgaria, Czech Republic, Estonia, Latvia, Hungary, Russia, Croatia and Romania for the first group; the U.K. and Denmark for the second group; Greece, Slovenia and Slovakia for the euro periphery, and Germany, France, Luxembourg, Austria for the core euro area.

<sup>13</sup>The exception is the dummies for Hungary, but these do not constitute a concern.

<sup>14</sup>This conjecture is more valid for the subsample of emerging economies than for advanced ones.

Therefore, even though we cannot rely on a price-quantity split to disentangle supply and demand factors, several variables are more likely to reflect one of the two. Of course this interpretation is somewhat conjectural and is to be taken with caution.

#### 4.4 Drivers of domestic foreign currency lending

The regression results for net new Swiss franc lending to non-bank residents are presented in Table 2. The first column presents the results for the entire sample, with the remaining columns presenting the results for the various country sub-groups. As pointed out above, domestic lending in foreign currency is highly heterogeneous, and most prevalent in emerging economies and in the euro periphery countries. Our discussion thus focuses on these groups, corresponding to the second and fourth specifications.

Our results show that domestic growth and inflation do not play a significant role. While higher inflation is associated with more lending in Swiss francs overall, this result is not robust to splitting the sample across various groups. Movements in international trade flows matter for emerging Europe. A contraction in international trade reduces the lending in Swiss francs, an effect likely driven by lending to firms engaged in trade.

The evolution in lending in domestic currency is not significant. This indicates that the movements in Swiss franc lending do not simply parallel overall lending activity, controlling for other drivers (which would imply a positive coefficient), but do not offset it either through a reallocation between the franc and the domestic currency (which would lead to a negative coefficient).

The differential in funding costs enters significantly, both overall and for emerging Europe and the euro area periphery. Swiss franc lending is boosted by a lower interest rate in the Swiss franc market, as well as higher interest rates in the euro and US Dollar markets (this last aspect being also significant for advanced economies outside the euro area). Lending in Swiss francs thus reacts to the relative cost of funding in Swiss francs and other currencies. By contrast, lending is less responsive to new foreign currency funding. An exception is found in emerging Europe where more funding in Swiss francs lead to higher lending in that currency.

Exchange rates matter, but in a heterogeneous way. An appreciation of the Swiss franc, which makes loans in that currency more expensive, reduces the lending activity in that currency in emerging Europe. Conversely, an appreciation of the euro boosts Swiss franc lending in emerging Europe, as well as in non-euro area advanced economies and overall. Exchange rate developments also have some impact through their volatility. Overall, Swiss franc lending falls when the exchange rate vis-à-vis the Swiss franc and the dollar becomes more volatile, and increases when the euro exchange rate fluctuates more. The effect is however quite heterogeneous. Volatility plays no role in emerging Europe, and instead only matters for advanced economies outside the euro area (where a higher volatility of the Swiss franc exchange rate reduces lending) and in the euro periphery.

The provision of liquidity by the central banks of the foreign currencies plays only a marginal role, and tends to have the wrong sign with more liquidity in Swiss francs followed by a reduction in lending in emerging Europe. This suggests that our approach of lagging the explanatory variables only partially addresses the issue of simultaneity, as the large increases in liquidity took place during the crisis when lending contracted. Risk perceptions as proxied by the Vix index do not matter.

Policy measures matter. The measures taken by the Hungarian authorities in late 2011 and early 2012 lead to a strong reduction of Swiss franc lending to residents in that country. As pointed out below, there was a simultaneous increase in lending in other foreign currencies, suggesting a substitution effect of measures that were primarily aimed at reducing Swiss franc lending specifically.

The results for lending in other foreign currencies are presented in Table 3. Domestic growth plays a partial role, and inflation does not matter. International trade flows are more relevant, as lending in US Dollar in euro area countries is sensitive to international trade. This suggests that the domestic lending in foreign currency in the euro area is geared towards firms with international activities.

Funding costs play little role, in contrast to the role they play for Swiss franc lending. The spread vis-à-vis the Swiss franc rate is significant for some groups, albeit with the wrong sign. Funding in foreign currency matters, especially for emerging Europe where higher funding in euros is associated with a subsequent increase in euro lending.

Also in contrast to their role in lending in Swiss francs, exchange rate movements in terms of level (appreciation) and volatility do not play a clear role for lending in other foreign currencies.

The liquidity provision by central banks do not have significant effects, with the exception of dollar liquidity in emerging Europe, suggesting some substitution away from the euro as dollar funding becomes more abundant. Risk perceptions are not associated with a clear pattern of lending either.

As already pointed out above, the measures taken by Hungary to restrict Swiss franc currency lending had an impact, with the first measures in late 2011 raising euro denominated lending.

Overall, our results show a substantial heterogeneity in the drivers of lending across the Swiss franc and other foreign currencies, and across countries. Swiss franc lending is most sensitive to funding costs, funding availability, and exchange rate appreciations. The impact of these variables is primarily observed in emerging Europe, and to a lesser extent in the euro area periphery. We also observe a sensitivity to international trade, but only in emerging Europe. The regulatory measures taken by Hungary strongly reduced Swiss franc lending to domestic residents. By contrast, liquidity provision by central banks, and risk appetite do

	Full sample	Emerging Europe	Advanced non-Euro	Euro periphery	Euro core
Growth	0.00	0.00	-0.27	0.37	0.68
Inflation	0.52*	0.47	-2.59	0.52	-1.94
dlog(gross trade)	0.14*	0.16*	-0.25	0.06	0.20
dlog(domestic currency lending)	0.09	0.14	-0.11	-0.05	0.43
$i_{domestic} - i_{CHF}$	5.29*	4.49**	6.54	6.29**	0.17
$i_{domestic} - i_{USD}$	-1.71	-2.16*	5.94	-5.49***	0.88
$i_{domestic} - i_{EUR}$	-3.62**	-2.45*	-20.5*		
dlog(funding CHF)	0.01	0.08*	-0.04	0.00	0.22
dlog(funding OC)	-0.11	0.14	0.05	-0.05	-0.68**
CHF appreciation	-0.28	-0.53**	-1.32	0.43	-0.08
USD appreciation	0.00	0.08	-0.19	0.24	-0.20
EUR appreciation	1.00**	1.04*	3.09**		
CHF volatility	-0.31***	-0.01	-2.08**	-0.14	-0.40
USD volatility	-0.40**	-0.32	0.94	-0.92**	-0.03
EUR volatility	0.80*	0.29	1.95		
d(Swiss M0/GDP)	-0.16	-0.25***	-0.35	0.27	0.02
d(US M0/GDP)	1.01*	-0.09	-5.00	0.16	-1.57
d(EU M0/GDP)	0.49	0.34	0.50	1.44	-0.27
d(VIX)	-0.50	-0.66	3.14	-1.55	1.04
$D_{Hungary2011Q4}$	-0.04	-0.10***			
$D_{Hungary2012Q1}$	-0.14***	-0.08***			
$D_{Postfinance}$	0.00	-0.03***	-0.05	0.01	0.00
No. Obs	404	404	51	79	80
No. cross sections	17	17	2	3	4
R2 (R2-Adjusted)	0.22(0.14)	0.46(0.37)	0.36(-0.09)	0.51(0.35)	0.12(-0.16)

Table 2: Panel regression results for Swiss franc domestic lending flows

The dependent variable is the valuation adjusted relative change across the quarter in lending to domestic residents in Swiss francs. All explanatory variables are lagged one quarter. The four columns lists the parameter estimates for different sub-samples of countries. *fundingOC (CHF)* is funding in other foreign currencies (Swiss francs). All regressions include fixed effects. \*/\*\*/\*\* reflect significance at the 10%/5%/1% levels, using white clustered standard errors.  $D_{postfinance}$  is a dummy capturing a structural break in the monetary base for Switzerland in Q3 2013.

not have a significant impact.<sup>15</sup> Lending in other foreign currencies is associated with fewer drivers than lending in Swiss francs. Specifically, trade flows matter for euro area countries, whereas funding availability and policy restrictions have an impact in emerging Europe.

An interpretation of the results in terms of supply and demand factors, while somewhat speculative as discussed in section 4.3, indicates a prominent role for both aspects in emerging Europe. The relevance of interest rates and funding availability indicates that a more ample supply of Swiss franc funding finds its way into lending. Policy measures that can restrict the availability of lending also matter, with the measures taken by Hungary in 2011-2012 leading to a clear contraction in Swiss franc lending, with some offset in euro lending. The sensitivity to trade flows is indicative of demand factors, while the interpretation of exchange rate movements is more ambiguous. The impact of international trade for lending in other foreign currencies in the euro area points to the relevance of demand factors.

#### 4.5 Drivers of cross-border lending

We now turn to lending across borders. Table 4 shows the regression results for lending in Swiss francs. As this form of lending is limited primarily to advanced economies, we focus our discussion on the pattern in advanced economies, corresponding to the third and fifth specifications respectively.

We find that only some explanatory variables matter, primarily in the forms of international trade, funding costs and exchange rate considerations. Specifically, Swiss franc lending is sensitive to international trade in the core euro area countries. There is some substitution away from cross border lending in Swiss francs for non-euro area countries when the interest rate in euro is low. An appreciation of the Swiss franc also matters for these countries, albeit with an unexpected sign as lending increases when the Swiss franc appreciates. This may reflect a need for the borrowing foreign banks to increase their Swiss franc funding when Swiss franc positions increase due to valuation effects. Exchange rate volatility, liquidity provisions, and risk perceptions have no significant impact.

The results for cross-border lending in other foreign currencies are presented in Table 5. We again observe a role for international trade flows in the core euro area economies. Funding costs play a role in advanced economies, albeit with an unexpected sign.

Exchange rate developments matter, with an appreciation of the Swiss franc boosting lending in emerging Europe and non-euro advanced economies. Conversely, lending is reduced when foreign currencies appreciate. Exchange rate volatility plays a marginal role, with a reduction in lending by core euro area banks in periods of high volatility in the Swiss franc exchange rate. This pattern could possibly reflect lending in foreign currency by banks in the euro area to banks in emerging Europe, which in turn use this funding to extend lending in

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<sup>15</sup>The absence of impact of liquidity provision could simply be due to the impact being fully captured through interest rates.

	Full sample	Emerging Europe	Advanced non-euro	Euro periphery	Euro core
Growth	0.00	0.00	0.01	0.02	0.74*
Inflation	0.34	0.14*	-1.06	0.69	-0.40
dlog(gross trade)	0.19**	-0.04	-0.10	0.87	0.27*
dlog(domestic currency lending)	-0.11	-0.03	-0.38	0.33	-0.42
$i_{domestic} - i_{CHF}$	3.07***	1.82	5.00***	-0.23	3.39**
$i_{domestic} - i_{USD}$	-1.19	-1.20*	-0.62	1.73	-2.39
$i_{domestic} - i_{EUR}$	-1.65	-0.98	-1.12		
dlog(funding CHF)	0.01	0.00	0.01	0.01	0.03
dlog(funding OC)	0.04	0.56*	0.00	-0.08	-0.29**
CHF appreciation	-0.08	0.14	0.13	-1.15	-0.24
USD appreciation	0.13	0.07	0.14	0.20	0.22
EUR appreciation	-1.15	-1.43	0.06		
CHF volatility	-0.15	0.09	-0.45***	-0.60	-0.14
USD volatility	0.11	0.29	-0.03	0.84	-0.09
EUR volatility	0.25	-0.26	0.62		
d(Swiss M0/GDP)	-0.08	-0.07	-0.12	0.27	-0.04
d(US M0/GDP)	-1.09*	-1.37**	-1.37	-1.64	0.20
d(EU M0/GDP)	-0.07	-0.05	0.50	-0.14	-0.10
d(VIX)	1.07	0.79	3.27**	3.91	-2.10
$D_{Hungary2011Q4}$	0.08	0.07**			
$D_{Hungary2012Q1}$	-0.01	0.10			
$D_{postfinance}$	-0.02	0.00	0.01	-0.03	-0.09***
Number of observations	404	194	51	79	80
Number of cross sections	17	8	2	3	4
R2 (R2-Adjusted)	0.23(0.14)	0.52(0.43)	0.63(0.37)	0.21(-0.04)	0.33(0.10)

Table 3: Panel regression results for other foreign currency domestic lending flows

The dependent variable is the valuation adjusted relative change across the quarter in lending to domestic residents in foreign currencies other than the Swiss franc, namely the euro for emerging Europe and the U.S. dollar for the other groups. All explanatory variables are lagged one quarter.  $fundingOC$  ( $CHF$ ) is funding in other foreign currencies (Swiss francs). The four columns lists the parameter estimates for different sub-samples of countries. All regressions include fixed effects. \*/\*\*/\*\* reflect significance at the 10%/5%/1% levels, using white clustered standard errors.  $D_{postfinance}$  is a dummy capturing a structural break in the monetary base for Switzerland in Q3 2013.

Swiss franc. Higher risk perceptions also reduce cross-border lending by banks in core euro area countries. Finally, Hungarian policy initiatives to reduce Swiss franc lending in late 2011 did not spill over into cross border lending.

Overall the results shows that our explanatory variables affect cross-border lending mostly in foreign currencies other than the Swiss franc, which likely reflects the fact that this form of lending is secondary for Swiss franc positions. International trade and exchange rate considerations matter, albeit in a highly heterogeneous manner. In terms of supply and demand factors, the role of international trade in cross-border lending in other foreign currencies by core euro area banks can be read as a demand factor. The impact of the sensitivity to risk relates more to supply consideration, while the interpretation of exchange rate volatility is more ambiguous.

## 5 Conclusions

Using a novel database on lending in Swiss francs and other foreign currencies, we show that banks' use of foreign currencies for lending activities is highly heterogeneous. The Swiss franc is to a high degree used for lending to domestic residents, whereas other foreign currencies are used relatively more for lending across border. The Swiss franc is primarily used for mortgage lending to domestic households, while domestic lending in other foreign currencies primarily goes to firms. Finally, banks' Swiss franc lending is not funded on balance sheet, in sharp contrast to other foreign currency lending.

The various foreign currencies also show differentiated sensitivity to explanatory variables. Swiss franc domestic lending is sensitive to funding costs, exchange rate developments, the availability of funding, and to some extent international trade activity. Domestic lending in other foreign currencies shows a more limited responsiveness to the factors we consider, but lending across borders is more sensitive. Policy measures aimed at foreign currency lending also matter, although the evidence is so far limited to the case of Hungary.

The overall message emerging from the analysis is that different currencies play very different roles in bank balance sheets. There are no one size fits all patterns or policy responses for containing negative side effects. Policies that aim to shield local economies from bank risk taking and foreign shocks through banks' international balance sheets should be tailored to the specific circumstances of the country in question, and the roles that different currencies play.

	Full sample	Emerging Europe	Advanced non-euro	Euro periphery	Euro core
Growth	0.00	-0.03	0.10	1.15	-0.17
Inflation	3.27	3.57	-5.85	-3.98	2.62
dlog(gross trade)	-0.63	-0.06	0.09	-3.97	0.39**
dlog(domestic currency lending)	-0.03	0.95	-1.66	-6.76	0.15
$i_{domestic} - i_{CHF}$	10.38	24.69	10.82	51.16	-3.74
$i_{domestic} - i_{USD}$	-3.55	1.03	-1.13	-15.68	-2.13
$i_{domestic} - i_{EUR}$	-9.69	-32.41	-31.08*		
dlog(funding CHF)	-0.08	-0.27	0.05	-0.09	-0.11
dlog(funding OC)	-0.57	-1.96	0.60	-0.41	-0.02
CHF appreciation	0.43	-0.62	3.01**	6.82	0.21
USD appreciation	0.18	-1.16	0.17	2.22	-0.40*
EUR appreciation	-0.68	2.27	-1.68		
CHF volatility	-0.14	-0.89	-0.18	0.72	-0.25
USD volatility	-0.97	0.36	0.13	-9.87	-0.18
EUR volatility	3.23	1.70	-7.99		
d(Swiss M0/GDP)	-0.85	-0.89	0.28	-1.80	-0.42*
d(US M0/GDP)	-0.88	-2.58	6.04	-5.10	1.64
d(EU M0/GDP)	1.05	-0.36	2.58	3.36	1.42
d(VIX)	-12.90*	-20.10	-7.40	-15.02	-0.52
$D_{Hungary2011Q4}$	0.31	0.43			
$D_{Hungary2012Q1}$	0.09	-0.24			
$D_{postfinance}$	-0.01	-0.11	0.43***	-0.16	-0.04
Number of observations	404	194	51	79	80
Number of cross sections	17	8	2	3	4
R2 (R2-Adjusted)	0.07(-0.02)	0.10(-0.05)	0.46(0.07)	0.16(-0.10)	0.42(0.22)

Table 4: Panel regression results for Swiss franc cross-border lending flows

The dependent variable is the valuation adjusted relative change across the quarter in lending to foreign residents in Swiss francs. All explanatory variables are lagged one quarter. *fundingOC (CHF)* is funding in other foreign currencies (Swiss francs). The four columns lists the parameter estimates for different sub-samples of countries. All regressions include fixed effects. \*/\*\*/\*\* reflect significance at the 10%/5%/1% levels, using white clustered standard errors.  $D_{postfinance}$  is a dummy capturing a structural break in the monetary base for Switzerland in Q3 2013.



	Full sample	Emerging Europe	Advanced non-euro	Euro periphery	Euro core
Growth	0.00	0.00	-0.05	1.02	0.47
Inflation	-0.06	-0.27	0.60	-0.03	0.67
dlog(gross trade)	-0.30	-0.53	0.49	0.02	0.32*
dlog(domestic currency lending)	-0.16	0.19	-0.28	-0.01	-0.12
$i_{domestic} - i_{CHF}$	4.34*	3.33	5.13**	3.01	3.76*
$i_{domestic} - i_{USD}$	-2.62	-2.31	-5.09**	-1.52	-3.92**
$i_{domestic} - i_{EUR}$	-2.09	-1.72	-3.05		
dlog(funding CHF)	0.02	0.14	0.00	-0.04	0.13
dlog(funding OC)	0.03	0.03	-0.23	0.13	-0.17
CHF appreciation	0.88**	1.24*	0.95**	-0.16	-0.27
USD appreciation	-0.41*	-0.92**	0.15	-0.15	0.07
EUR appreciation	0.71	1.25	-0.83**		
CHF volatility	-0.21*	-0.21	-0.05	-0.35	-0.31**
USD volatility	-0.27	0.03	-0.71	0.13	0.38
EUR volatility	0.68	0.06	-0.64		
d(Swiss M0/GDP)	0.39**	0.02	0.18	1.40***	0.38**
d(US M0/GDP)	-0.63	-0.74	1.61	1.23	-0.97
d(EU M0/GDP)	-1.93**	-2.56	0.61	-2.07	-2.13***
d(VIX)	-0.95	-0.31	-1.67	-3.01	-2.31**
$D_{Hungary2011Q4}$	-0.03	0.01			
$D_{Hungary2012Q1}$	-0.01	0.07			
$D_{postfinance}$	-0.08***	-0.18***	0.05*	-0.05	-0.05
Number of observations	404	194	51	79	80
Number of cross sections	17	8	2	3	4
R2 (R2-Adjusted)	0.10(0.01)	0.13(-0.03)	0.48(0.11)	0.32(0.10)	0.28(0.04)

Table 5: Panel regression results for other foreign currency cross-border lending flows. The dependent variable is the valuation adjusted relative change across the quarter in lending to foreign residents in foreign currencies other than the Swiss franc, namely the euro for emerging Europe and the U.S. dollar for the other groups. All explanatory variables are lagged one quarter.  $fundingOC$  ( $CHF$ ) is funding in other foreign currencies (Swiss francs). The four columns lists the parameter estimates for different sub-samples of countries. All regressions include fixed effects. \*/\*\*/\*\* reflect significance at the 10%/5%/1% levels, using white clustered standard errors.  $D_{postfinance}$  is a dummy capturing a structural break in the monetary base for Switzerland in Q3 2013.

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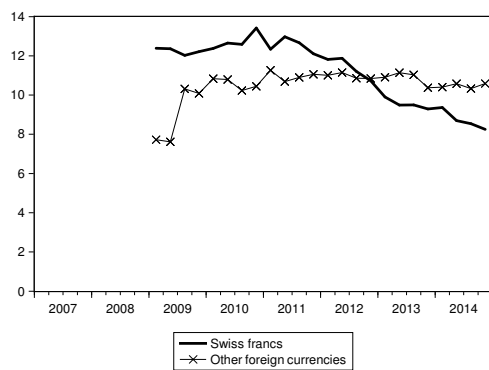
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## 6 Appendix A: Data sources and definitions

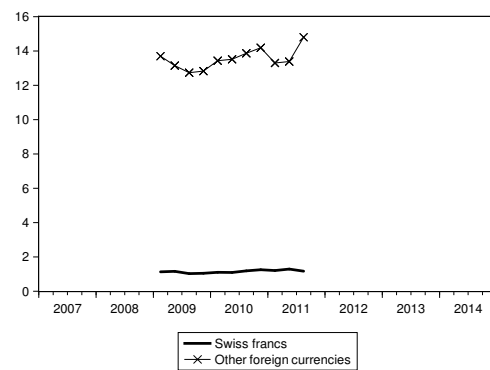
- All balance sheet data for European countries are derived from the Swiss National Bank's Swiss franc lending monitor database.
- Valuation adjusted flows in bank balance sheet positions in different currencies are from Krogstrup and Tille [2016].
- Nominal GDP: Quarterly, seasonally adjusted, quarterly values, not annualized. Source: IFS.
- Real GDP: Index, 2005=100, seasonally adjusted. Source: IFS.
- Growth is defined as the quarter on quarter annualized percentage change in real GDP.
- Consumer price index. Source: IFS.
- Inflation is defined as the quarter on quarter annualized percentage change in the CPI.
- 3-month money market interest rates: Average of daily rates across the quarter. For euro countries, euribor. Sources: Swiss National Bank and Datastream.
- Exchange rates. Average of daily rates over the quarter. Vis-à-vis the euro: Local currency per euro nominal exchange rate. Includes the euro exchange rates for euro countries, relating to their pre-euro currency. Vis-a-vis the USD: Local pre-euro currency per USD. Vis-à-vis the CHF: Local currency per Swiss franc. For euro countries, the euro Swiss franc exchange rate has been used. Source: Datastream.
- Exchange rate volatilities are computed as the quarterly average of the daily squared change in the log of the exchange rate.
- US monetary Base. Adjusted for reserve requirement changes. Quarterly average of monthly levels. Source: St Louis Federal Reserve. In millions USD.
- Euro area monetary base: Quarterly average of monthly levels. Source: BIS. In millions euro.
- Swiss monetary base: Quarterly average of monthly levels. Source: SNB. In millions of Swiss francs.
- Federal Reserve bilateral USD currency swap volumes. Source: Federal Reserve. Quarterly averages, in millions of USD.
- SNB bilateral Swiss franc currency swap volumes. Source: SNB. Quarterly averages, in millions of Swiss francs.

- VIX: Options based expected stock price volatility, based on the S&P, calculated by the CBOE. Source: Datastream.
- Leverage of US securities brokers and dealers: As defined in Arian et al. [2014], page 9. Source of total assets and liabilities of securities brokers and dealers: US Financial Accounts (<http://www.federalreserve.gov/datadownload/Build.aspx?rel=Z1>). Quarterly, based on end-of-quarter accounts.
- Exports and imports of goods and services: Quarterly, nominal, not seasonally adjusted. Source: IFS.

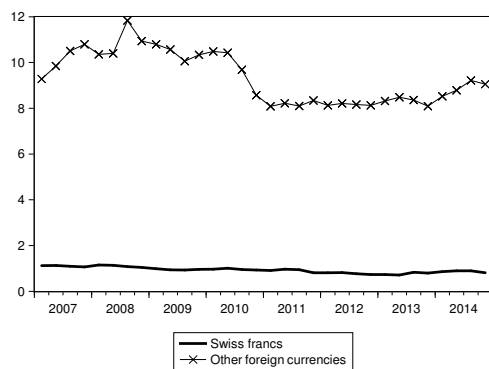
## 7 Appendix B: Country specific figures



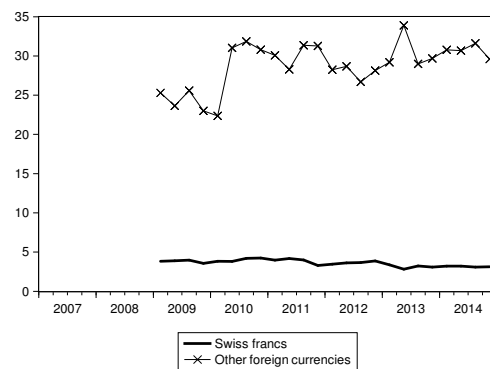
(a) Austria



(b) France



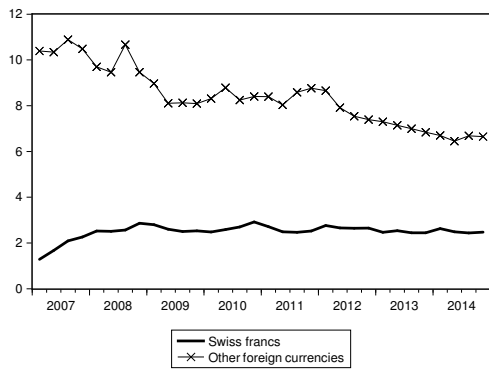
(c) Germany



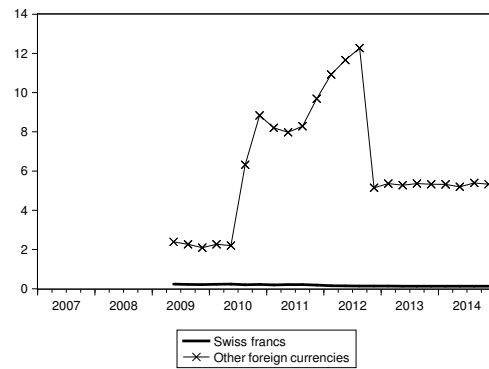
(d) Luxembourg

Figure 7: Euro countries financial centers: Foreign currency denominated assets in percent of total assets.

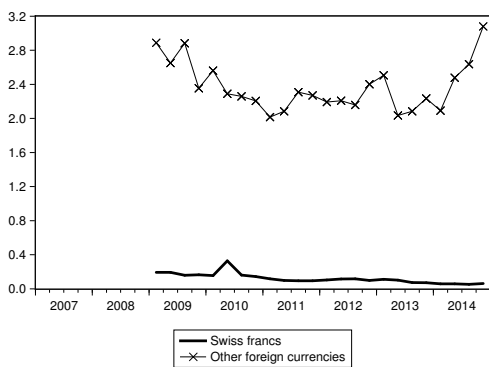
Source: SNB.



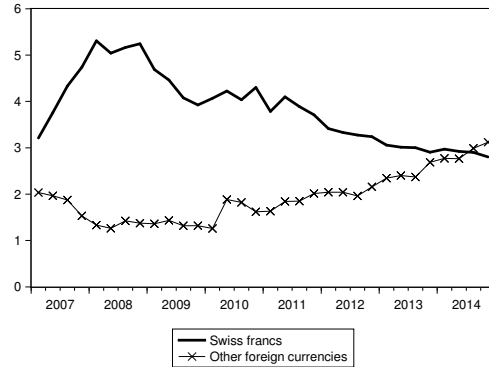
(a) Greece



(b) Italy



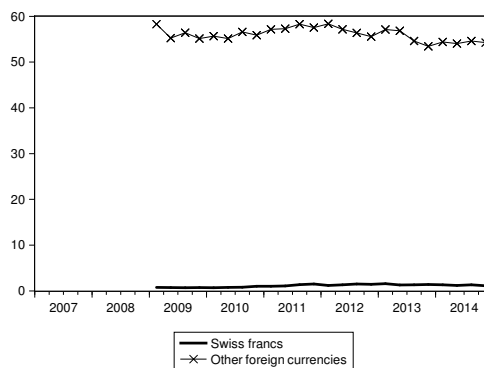
(c) Slovakia



(d) Slovenia

Figure 8: Euro countries non-financial centers: Foreign currency denominated assets in percent of total assets.

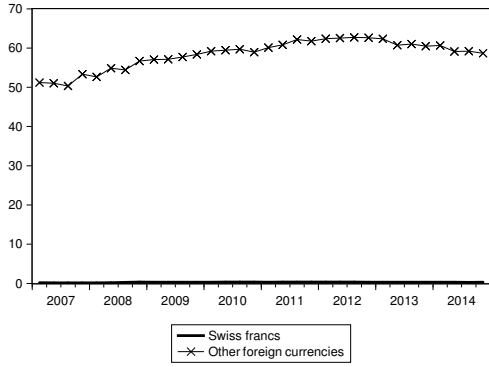
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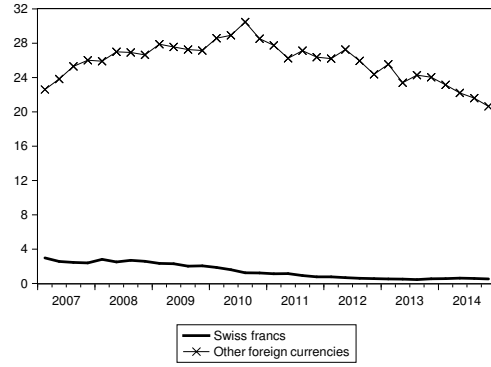
(a) Great Britain

Figure 9: Non-euro countries financial centers: Foreign currency denominated assets in percent of total assets.

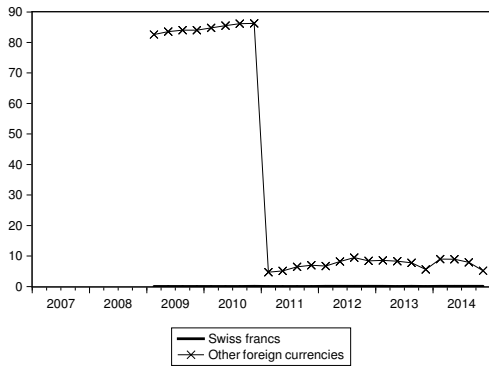
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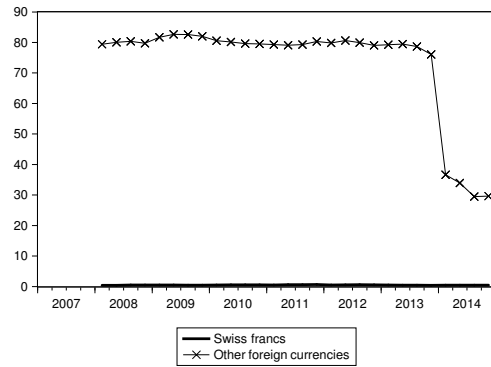
(a) Bulgaria



(b) Denmark



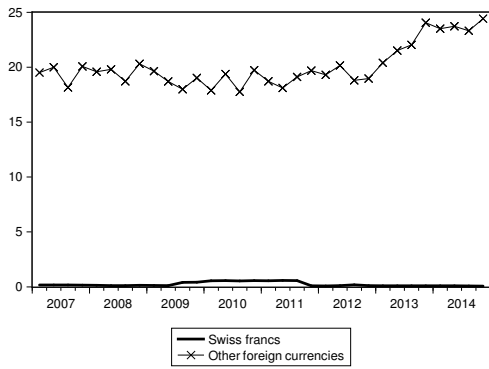
(c) Estonia



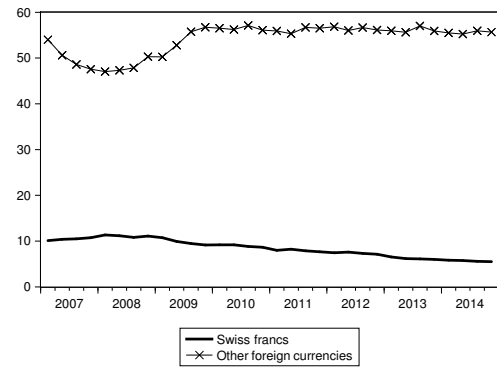
(d) Latvia

Figure 10: Non-euro countries non-financial centers, pegs: Foreign currency denominated assets in percent of total assets.

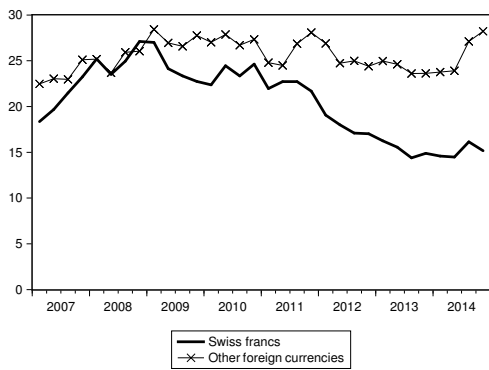
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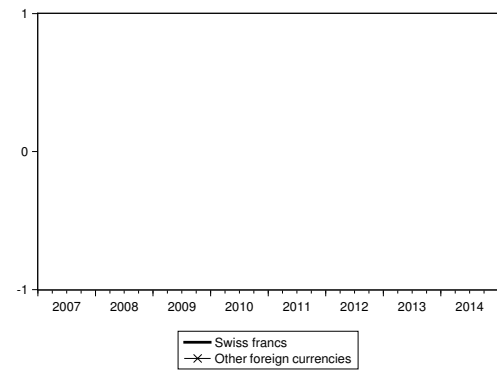
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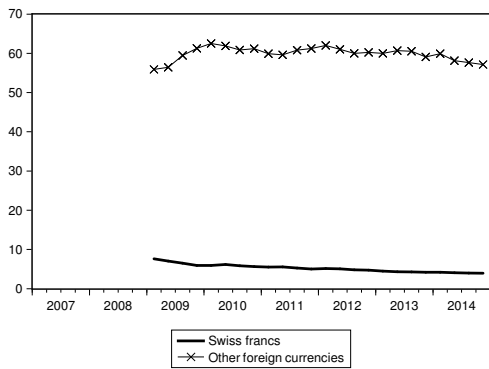
(b) Croatia



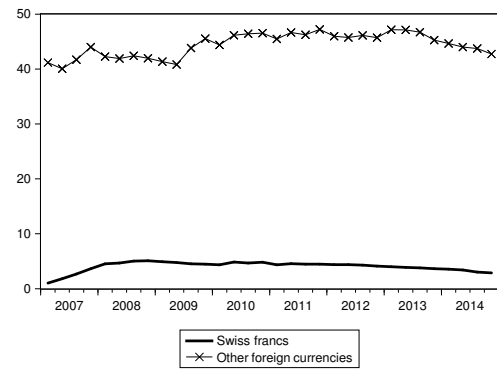
(c) Hungary



(d) Poland



(e) Serbia

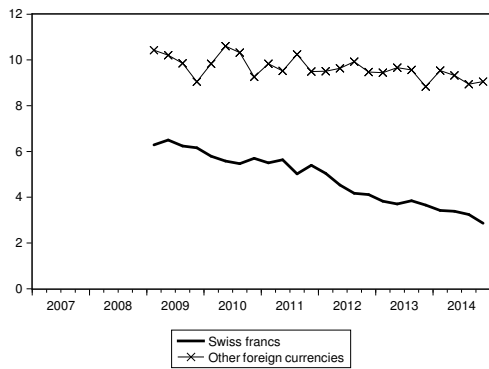


(f) Romania

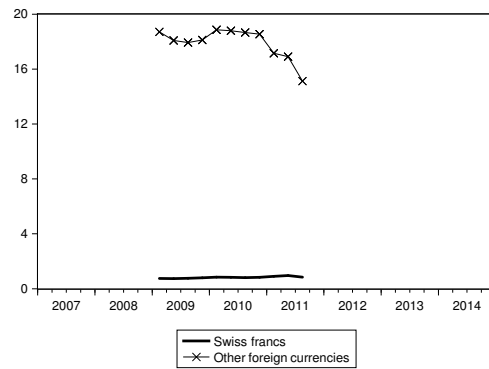
Figure 11: Non-euro countries non-financial centers, no pegs: Foreign currency denominated assets in percent of total assets.

Source: SNB.

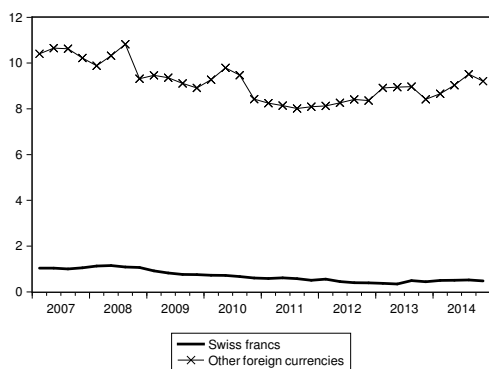




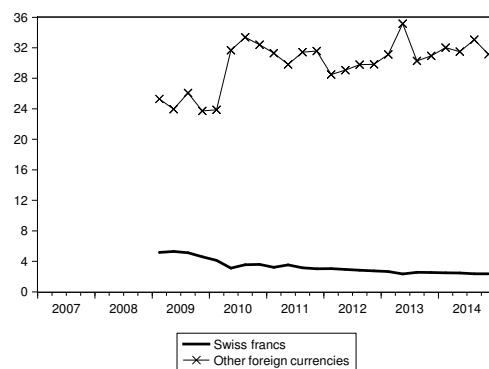
(a) Austria



(b) France



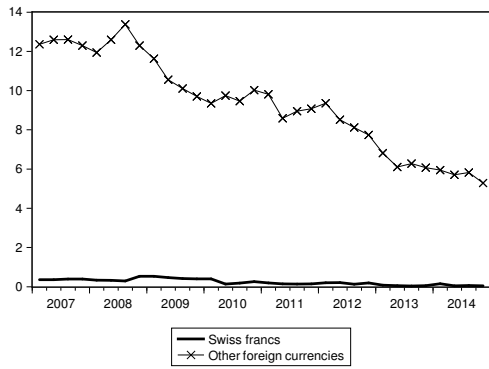
(c) Germany



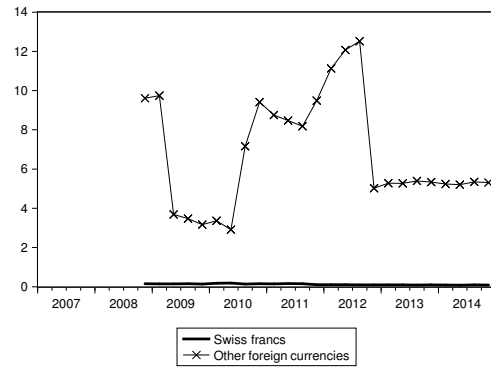
(d) Luxembourg

Figure 12: Euro countries financial centers: Foreign currency denominated liabilities in percent of total liabilities.

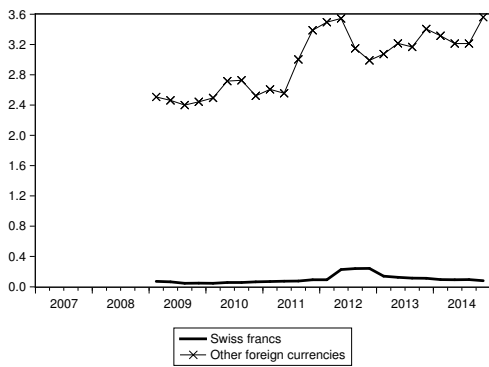
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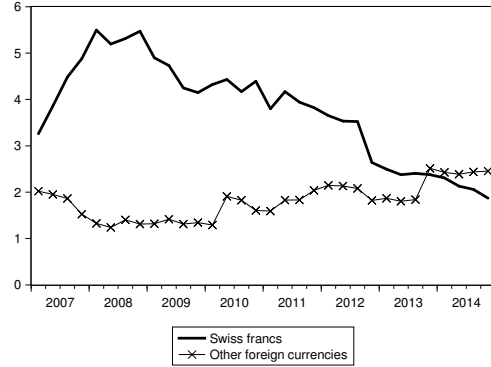
(a) Greece



(b) Italy



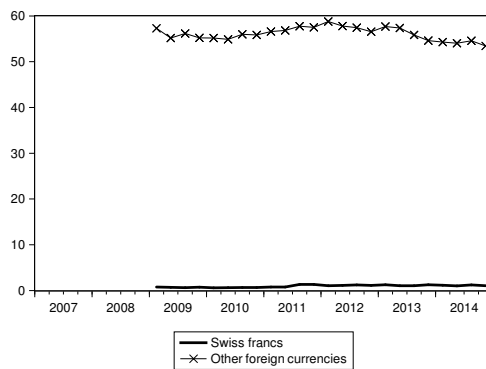
(c) Slovakia



(d) Slovenia

Figure 13: Euro countries non-financial centers: Foreign currency denominated liabilities in percent of total liabilities.

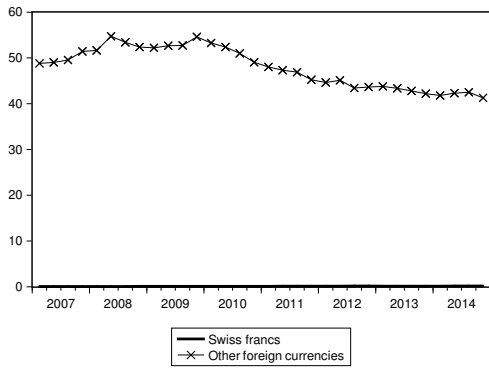
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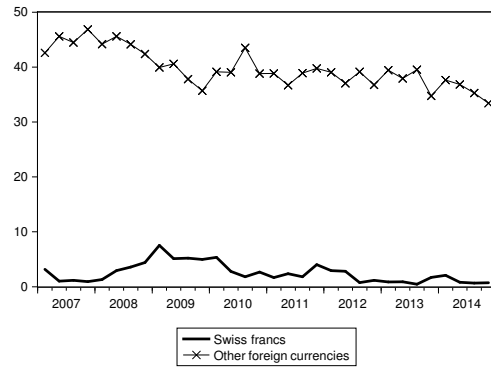
(a) Great Britain

Figure 14: Non-euro countries financial centers: Foreign currency denominated liabilities in percent of total liabilities.

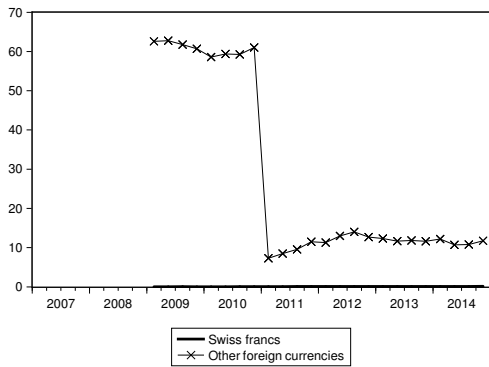
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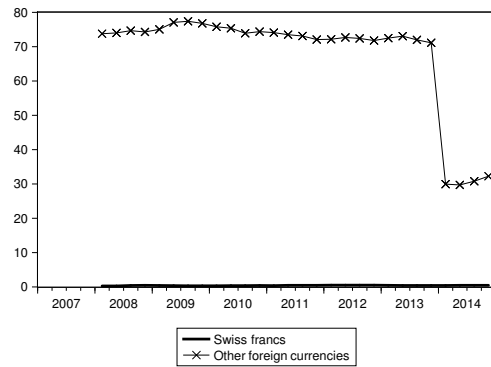
(a) Bulgaria



(b) Denmark



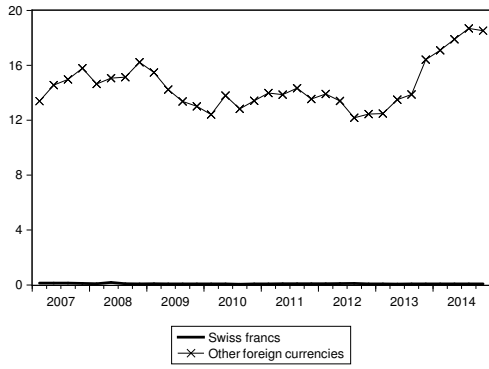
(c) Estonia



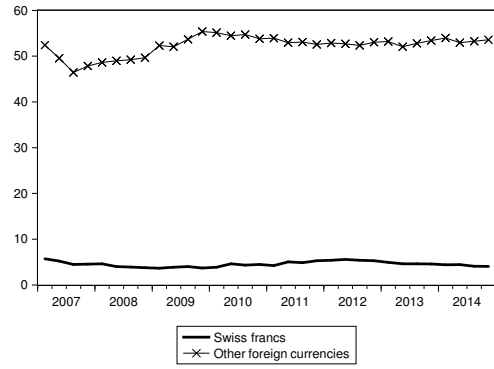
(d) Latvia

Figure 15: Non-euro countries non-financial centers, pegs: Foreign currency denominated liabilities in percent of total liabilities.

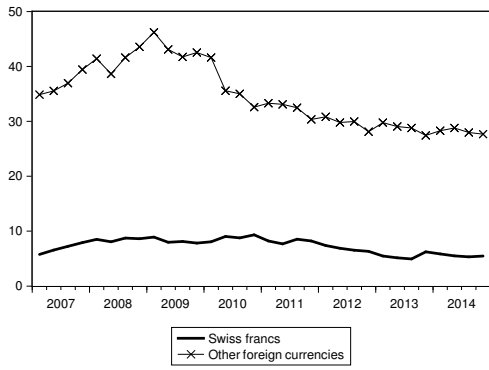
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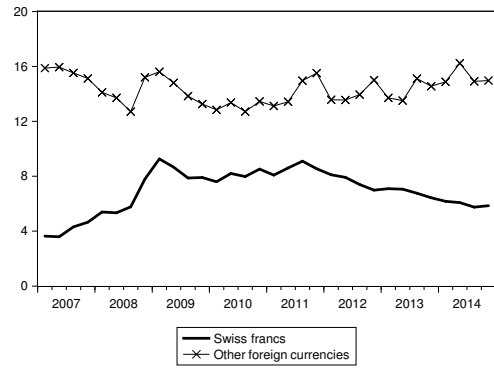
(a) Czech Republic



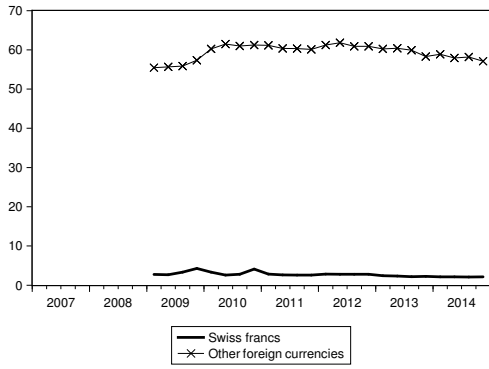
(b) Croatia



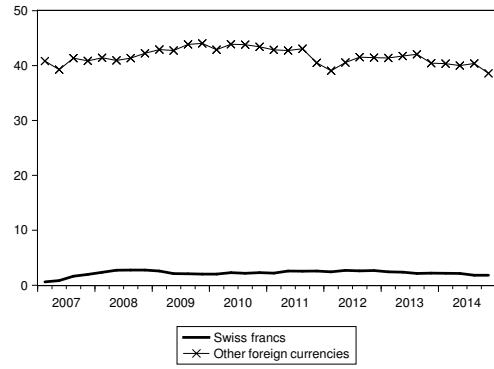
(c) Hungary



(d) Poland



(e) Serbia



(f) Romania

Figure 16: Non-euro countries non-financial centers, no pegs: Foreign currency denominated liabilities in percent of total liabilities.

Source: SNB.

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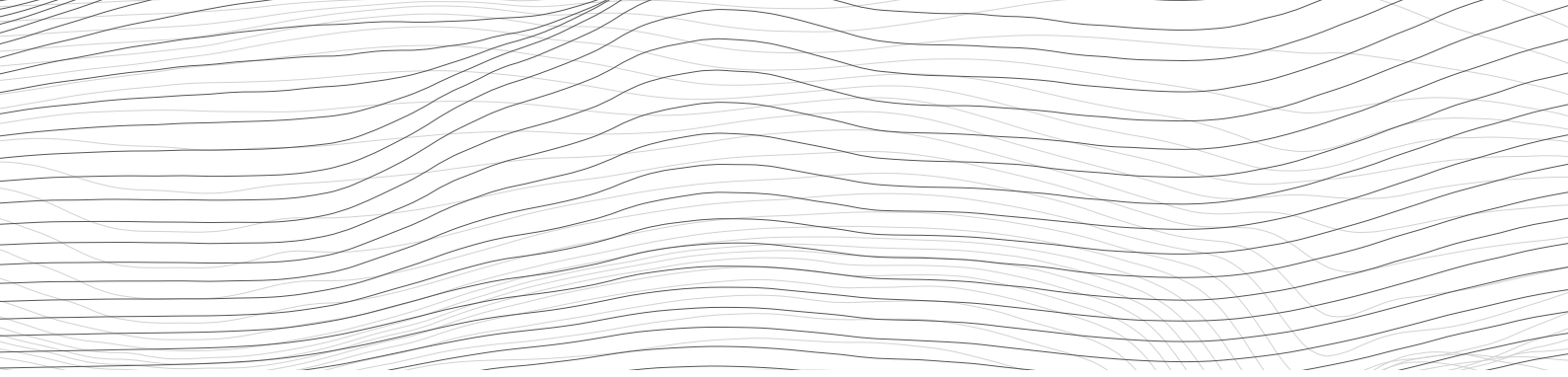
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