

What drives the funding currency mix of banks?

Signe Krogstrup

Swiss National Bank

Cédric Tille

*Graduate Institute for International and Development Studies,
and Center for Economic Policy Research (CEPR)*

Spillovers of conventional and unconventional monetary policy

Zurich, July 9-10, 2015

The views in this paper are solely the responsibility of the authors
and do not necessarily reflect the views of the Swiss National Bank

Use of foreign currencies by banks

- Large and fast growing use before the crisis, notably in Eastern Europe (e.g. mortgages in euro and Swiss franc).
 - Research on use of foreign currencies in lending (Brown and de Hass 2012, Takats 2010, Yesin 2013), deposits (Brown and Stix 2014), and wholesale funding (Auer and Kraenzlin 2011).
- While the euro plays a dominant role, the Chf was also used (Christensens and Krogstrup 2014, Ranaldo and Soderlind 2010).
- Funding considerations matter for international transmission through banks' activities (Bruno and Shin 2014, Cetorelli and Goldberg 2011).
- While the literature contrasts domestic vs. foreign currencies, there is little study of heterogeneity among foreign currencies.

Our contribution

- Use the lending monitor database of the SNB, which tracks lending and funding across currencies (domestic, CHF, other foreign) across 18 European countries.
- Assess the drivers of funding in CHF and other foreign currencies.
 - Funding costs, past and future exchange rate movements, risk considerations, movements in loans and deposits.
- Substantial heterogeneity across countries and currencies.
 - Chf funding in emerging Europe reflects exchange rate considerations and movements in loans.
 - Chf funding in the euro area financial centers reflects risk considerations, and funding costs aspects in other euro countries.
 - Funding in other currencies is also heterogeneous, but less sensitive to the drivers compared to the Swiss franc. The Chf may be a marginal funding currency.

A simple model of bank funding currency

- Focus on the funding decision across currencies (indexed by $i = \text{dom, chf, euro}$).

Loans	$S_t^i C_t^i$	$S_t^i D_t^i$	Deposits
		$S_t^i F_t^i$	Wholesale funds
		K_t	Equity

- Loans, deposits, exchange rates are exogenous. 2 periods.
 - 1: choose specific F_1^i in the 3 currencies given the overall wholesale funding.
 - 2: shocks to exchange rates and loans return. Payoffs and liquidation with final equity K_2 .

Orders and exchange rate

- Split variables in components of different orders.
 - Order 0: not proportional to innovations.
 - Order 1: linearly proportional to innovations.
 - Order 2: linearly proportional to the squares of innovations.
- Exchange rate of domestic currency vis-à-vis currency i .

$$S_1^i = S_0^i \exp(v_1^{S,i})$$

$$S_2^i = S_0^i \exp(v_1^{S,i} + \tau_2^{S,i} v_2^{S,i} + \varepsilon_2^{S,i})$$

- S_0^i is the zero-order component
- $v_1^{S,i}$ is a first-order component (shifts in the exchange rate).
- $v_2^{S,i}$ is a first-order component, it is scaled by a second-order term $\tau_2^{S,i}$ (scaling ensures a well defined solution).
- $\varepsilon_2^{S,i}$ is a first-order shock revealed in period 2.

Exchange rate shocks

- Consider two currencies, $i=euro, chf$
- $\varepsilon_2^{S,eur}$ and $\varepsilon_2^{S,chf}$ follow a normal distribution, with expected values of $-0.5Var(\varepsilon_2^{S,i})$.

- The variances and covariances are:

$$Var(\varepsilon_2^{S,i}) = \sigma_{fx}^2 (1 + v_2^{\sigma,i})$$

$$Covar(\varepsilon_2^{S,eur}, \varepsilon_2^{S,chf}) = 0.5\sigma_{fx}^2 v_2^{\rho}$$

- σ_{fx}^2 is a second-order term.
- $v_2^{\sigma,i}$ and v_2^{ρ} are first-order terms that capture shifts in variances and correlations (known in period 1).

Loans, deposits and funding

- The loans and deposits in the three currencies are exogeneous.
- Loans and deposits have zero-order and first-order terms (known in period 1). First-order terms reflect exogenous shifts.
- The payoff on loans in period 2 is affected by a first-order shock, unrelated to the exchange rates.
- The bank chooses the composition of funding across the three currencies. $F_1^i = F_0^i \exp(f_1^i)$ is the position in currency i , with F_0^i and f_1^i being endogeneous zero- and first-order components.
 - Positions in foreign currencies are affected by exchange rates.
 - There are difference (second- and third-order) in funding costs.

The position in period 2 is $F_2^i = F_0^i \exp\left(f_1^i + \tau_2^{q,i}(1 + v_2^{q,i})\right)$,

where $v_2^{q,i}$ and $\tau_2^{q,i}$ are first- and second-order terms.

Optimization

- In period 1 the bank maximizes the expected utility of final equity, denoted by $E_1 (1-\gamma)^{-1} (K_2)^{1-\gamma}$, subject to the constraint on total wholesale funding.
- The optimality conditions give two Euler conditions, showing that expected discounted return differentials are zero:

$$0 = E_1 (K_2)^{-\gamma} \left[\begin{array}{c} \exp(\tau_2^{q,i} (1 + v_2^{q,i}) + \tau_2^{S,i} v_2^{S,i} + \varepsilon_2^{S,i}) \\ -\exp(\tau_2^{q,dom} v_2^{q,dom}) \end{array} \right]$$

- We take a cubic expansion around the zero-order allocation.
- The second-order component of the equation gives the first-order component of the funding positions.
- The third-order component of the equation gives the second-order component of the funding positions.

Zero-order solution

- The funding at period zero reflects two elements.
- 1) offset the exchange rate exposure due to the loans and deposits in foreign currencies.
 - Net exposure to currency i : $Net_0^i = S_0^i [C_0^i - D_0^i - F_0^i]$.
 - Set F_0^i so that the net exposure is zero.
- 2) take advantage of different funding costs.
 - Higher funding in currency i (and thus negative net exposure $Net_0^i < 0$) if the funding cost is lower in that currency.
 - Funding cost differential is second-order, and scaled by the variance of the exchange rate.

$$Net_0^i = \frac{K_0}{\gamma} \frac{\tau_2^{q,i}}{Var(S_2^i)}$$

First-order solution

- Consider funding in Chf, denoted by f_1^{chf}
- It can increase if:
 - The Chf funding cost is low, relative to the domestic cost.
 - The Chf depreciates from 1 to 2 (at least appreciates by less).
 - The Chf is initially strong, and the zero-order position is long Chf. Rebalance valuation driven impact on net exposure.
 - Chf loans are high, or Chf deposits are low (adjusted for FX valuation). Rebalance net exposure.
 - The Chf exchange rate is more volatile and the zero-order position is long Chf. Reduce the magnitude of the net exposure.
 - The Chf and euro exchange rates are more positively correlated and the zero-order position is long euro. Euro and Chf are more similar, so funding switches towards Chf to raise long euro position.

The SNB lending monitor database

- Aggregate balance sheet positions of banks domiciled in 20 European countries (focus on 18). Collected from central banks.
 - Quarterly figures 2009 Q1 - 2014Q 2 (start in 2002 Q1 for some).
Banks allocated on the residency principle.
- Assets and liabilities split along several lines.
 - Currency: domestic, Swiss franc, all other foreign.
 - Types of assets: lending to households and non-financial firms, lending to banks, other.
 - Types of liabilities: deposits from households and non-financial firms, deposits from banks (interbank), own securities.
 - Our wholesale funding analysis focuses on interbank funding.

Selected stylized facts

- Foreign currencies positions are sizable (as share of total balance sheets) , mostly in emerging economies.
 - Dominant role of euro, substantial role of Chf in some.
- Heterogeneous uses of currencies.
 - Chf used mostly in lending to residents. Funded largely through foreign interbank.
 - Other foreign currencies used in lending to residents, as well as interbank. Funded more through residents' deposits..
- Heterogeneous net exposures across currencies (Yesin 2013).
 - Long positions in Chf, short positions in other foreign currencies.

Econometric analysis

- Split countries in three groups: emerging Europe, euro area financial centers, other euro area.
- Level and first difference specifications.
- Dependent variable: wholesale funding in Chf, and other FX.
 - Other is euro for emerging countries, US dollar for euro countries.
- Four groups of explanatory variables.
 - Funding costs: lagged liquidity in foreign currencies (M0), interest rate differentials.
 - Exchange rate movements: future (proxy for expectations), and lagged * Net exp.
 - Second moments of exchange rate distribution: intra-quarter weekly volatility (and correlation) * Net exp, and Vix * Net exp.
 - Changes in valuation-adjusted loans and deposits (lagged), in Chf and foreign currency (adjusted by currency weights).

Key results: Chf funding

- Substantial heterogeneity across the three countries groups.
- Emerging Europe: exchange rate movements, loans.
 - Future Chf appreciation reduces Chf funding.
 - Lagged Chf appreciation (* Net exposure), and lagged euro appreciation reduce Chf funding. Opposite to model predictions.
 - Could reflect backward looking expectations.
 - Higher Chf lending raises Chf funding.
- Euro countries (non financial centers): funding costs.
 - Lower Chf interest rate raises Chf funding.
- Euro financial centers: liquidity and risk-related considerations.
 - Higher euro (and US) liquidity reduces Chf funding.
 - Higher USD-Chf correlation (* net exposures) raises Chf funding.
 - Higher Vix (* net exposure) raises Chf funding.

Chf funding: emerging Europe

	First Diff.	Level
Swiss M0 in % GDP	-0.20	-0.35
Euro M0 in % GDP	-3.56	1.89
US M0 in % GDP	-6.01	-1.20
Spread int rate on domestic and CHF funding	0.03	-0.02 **
CHF exchange rate (+1)	-0.36 ***	-0.44 ***
CHF exch rate (-1) * NetExp CHF (-1)	-1.54 **	-0.02
FX exch rate (-1) * NetExp FX (-1) * NetExp CHF (-1)	-4.54 ***	0.04
Number of observations	199	213
Number of cross sections	8	8
R-Squared	0.1	0.97

Chf funding: emerging Europe

	First Diff.	Level
CHF exch rate volatility (+1) * NetExp CHF (-1)	0.65	1.11
Correl CHF and FX exch rates (+1) * NetExp FX (-1)	1.50	0.47
Vix (-1) * NetExp CHF (-1)	0.00	0.00
Valuation adjusted CHF loans (-1)	0.78 **	1.39 ***
Valuation adjusted CHF deposits (-1)	-0.13	0.07
Valuation adjusted FX loans (-1) * FX weights (-1)	0.75	0.19
Valuation adjusted FX deposits (-1) * FX weights (-1)	-0.71	-0.74 **
Number of observations	199	213
Number of cross sections	8	8
R-Squared	0.1	0.97

Chf funding: Euro (non centers)

	First Diff.	Level
Swiss M0 in % GDP	1.62	-1.29 **
Euro M0 in % GDP	0.48	3.46
US M0 in % GDP	-0.29	-1.03
Spread int rate on domestic and CHF funding	0.18 *	0.20 **
CHF exchange rate (+1)	0.94	1.39
CHF exch rate (-1) * NetExp CHF (-1)	-0.07	0.04
FX exch rate (-1) * NetExp FX (-1) * NetExp CHF (-1)	-1.41 **	0.07
Number of observations	95	102
Number of cross sections	4	4
R-Squared	0.37	0.98

Chf funding: Euro (non centers)

	First Diff.	Level	
CHF exch rate volatility (+1) * NetExp CHF (-1)	-34.4	-162.4	**
Correl CHF and FX exch rates (+1) * NetExp FX (-1)	-3.58	0.06	
Vix (-1) * NetExp CHF (-1)	0.00	0.00	
Valuation adjusted CHF loans (-1)	-0.20	-0.48	
Valuation adjusted CHF deposits (-1)	0.19	0.61	**
Valuation adjusted FX loans (-1) * FX weights (-1)	0.49	0.46	**
Valuation adjusted FX deposits (-1) * FX weights (-1)	0.41	1.41	***
Number of observations	95	102	
Number of cross sections	4	4	
R-Squared	0.37	0.98	

Chf funding: Euro (financial centers)

	First Diff.	Level
Swiss M0 in % GDP	0.08	-1.37 ***
Euro M0 in % GDP	-5.52 *	-0.99
US M0 in % GDP	-2.01	-2.81
Spread int rate on domestic and CHF funding	0.00	0.08
CHF exchange rate (+1)	0.59	-2.09 ***
CHF exch rate (-1) * NetExp CHF (-1)	-1.27	0.80
FX exch rate (-1) * NetExp FX (-1) * NetExp CHF (-1)	60.47	8.94
Number of observations	76	82
Number of cross sections	4	4
R-Squared	0.22	0.89

Chf funding: Euro (financial centers)

	First Diff.	Level
CHF exch rate volatility (+1) * NetExp CHF (-1)	-536.5	-732.6
Correl CHF and FX exch rates (+1) * NetExp FX (-1)	1.32 *	-1.07 **
Vix (-1) * NetExp CHF (-1)	0.02 **	0.01
Valuation adjusted CHF loans (-1)	0.03	0.41 **
Valuation adjusted CHF deposits (-1)	0.00	-0.26 *
Valuation adjusted FX loans (-1) * FX weights (-1)	-0.07	-1.62 **
Valuation adjusted FX deposits (-1) * FX weights (-1)	-0.02	1.13 ***
Number of observations	76	82
Number of cross sections	4	4
R-Squared	0.22	0.89

Key results: other FX funding

- Emerging Europe: exchange rate movements, loans.
 - Future euro appreciation reduces euro funding (sensitive).
 - Higher euro lending raises euro funding.
- Euro countries (non financial centers): exchange rate.
 - Lagged USD appreciation reduces euro funding (sensitive).
- Euro financial centers: no robust results.
 - No drivers are significant in the first difference specification.
- Fewer drivers are significant compared to the CHF.
 - Could indicate that the Chf is used as a marginal funding source, while other foreign currencies are more established (and less sensitive) funding sources.

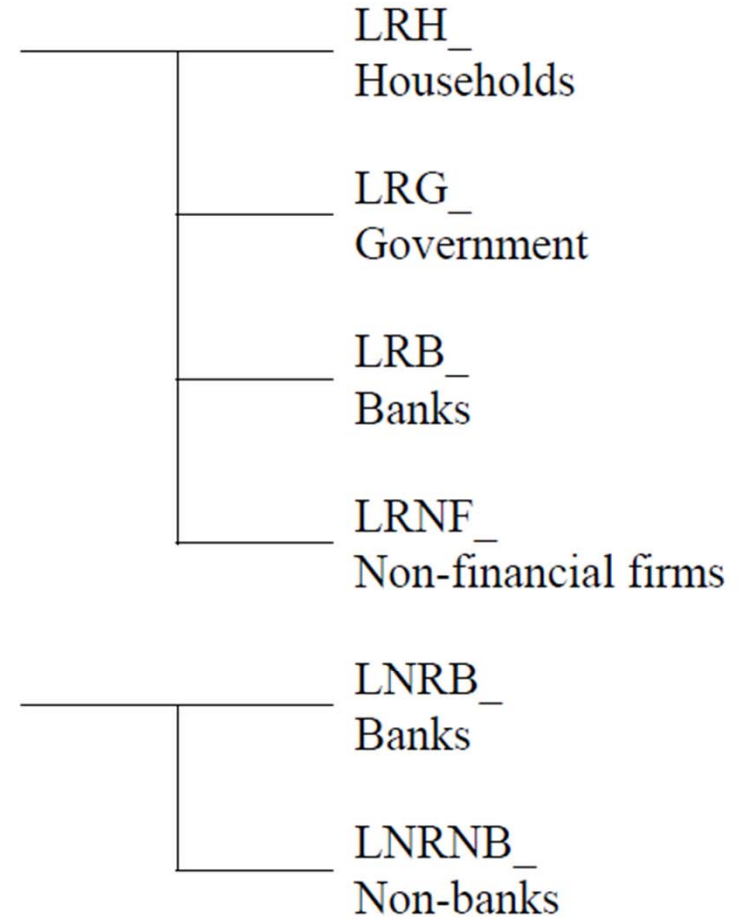
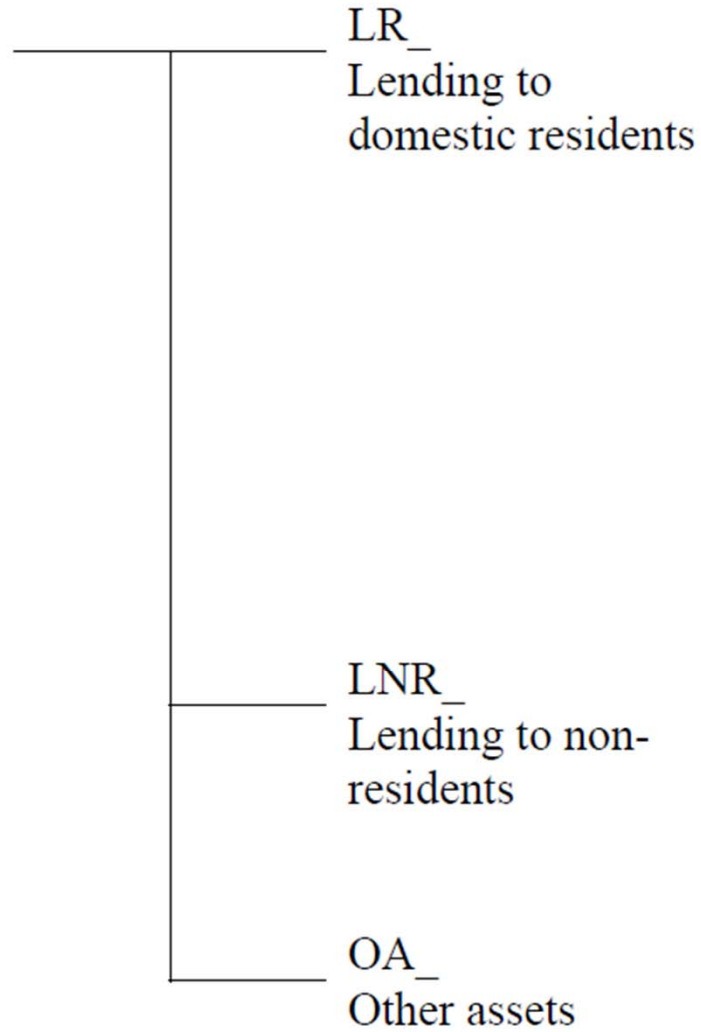
Conclusions and further steps

- Substantial heterogeneity in the drivers of banks' wholesale funding.
 - Across currencies, with the Chf more sensitive to drivers.
 - Across country groups.
- Expand on the specifications beyond the level and first-difference to better capture dynamics (in progress).
 - Error correction model.
 - VAR approach to assess the dynamics at different horizons.
- Expand on measures of exchange rate expectations.
 - Survey of forecasters.
 - Forward markets (but issue of volatile premia).
- Broaden measure of funding (own securities, ./ liquid assets).

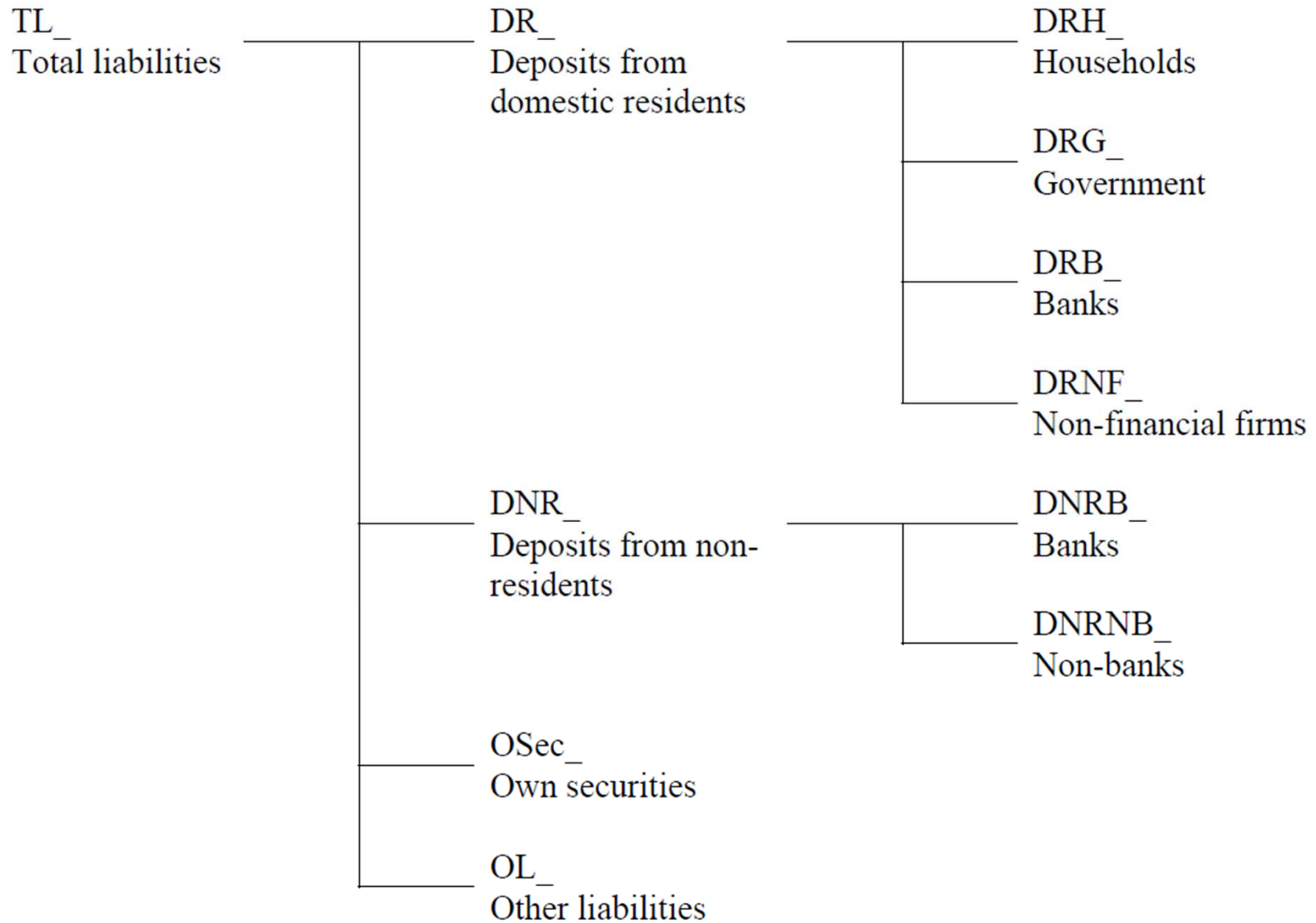
EXTRA SLIDES

Assets

TA_
Total assets



Liabilities



A

FX positions are large

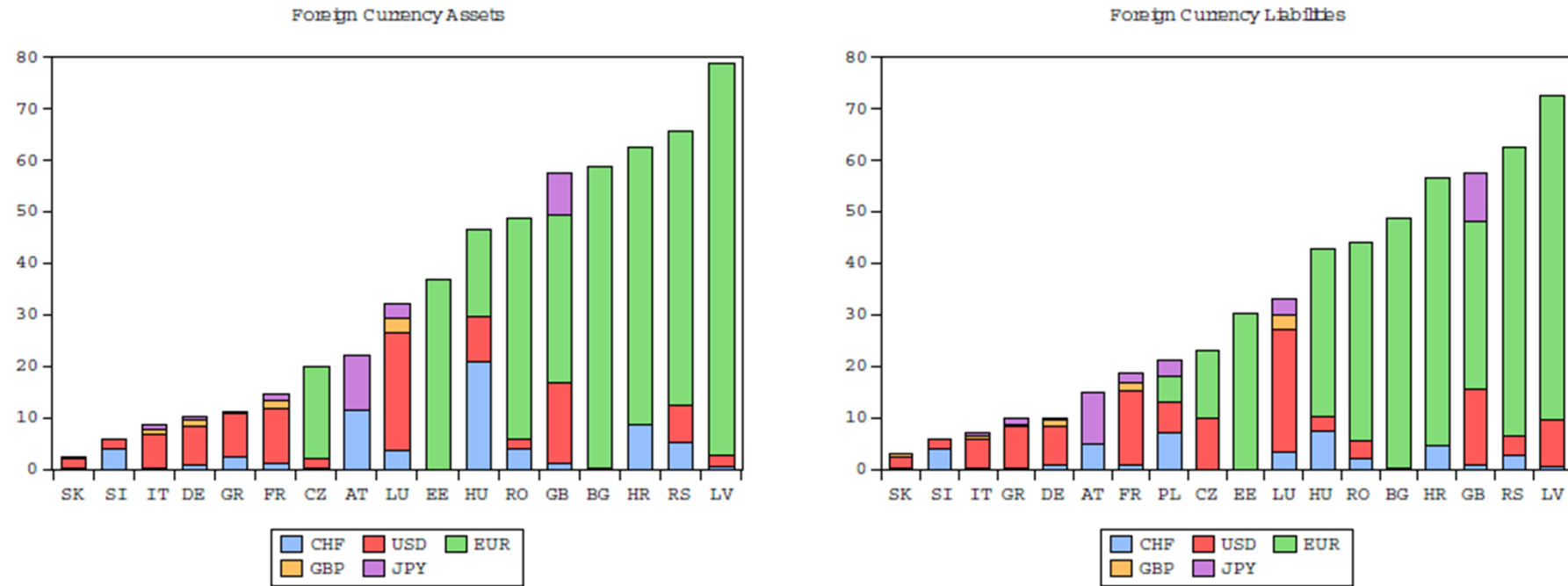


Figure 2: Foreign currency composition across countries

The upper panels show foreign currency assets and liabilities, in percent of total balance sheet positions (2007-2014 averages). As Austria, Czech Republic, France and Poland neither report total assets and liabilities nor other assets and other liabilities, the bars for these countries reflect only the remaining balance sheet items. The lower panels show lending and deposits to or from foreign residents, in percent of total balance sheet positions. In the left hand panels, foreign currency and cross border assets of Poland are set to zero as Poland does not report asset positions in foreign currency. Source: SNB.

Uses of the Swiss franc

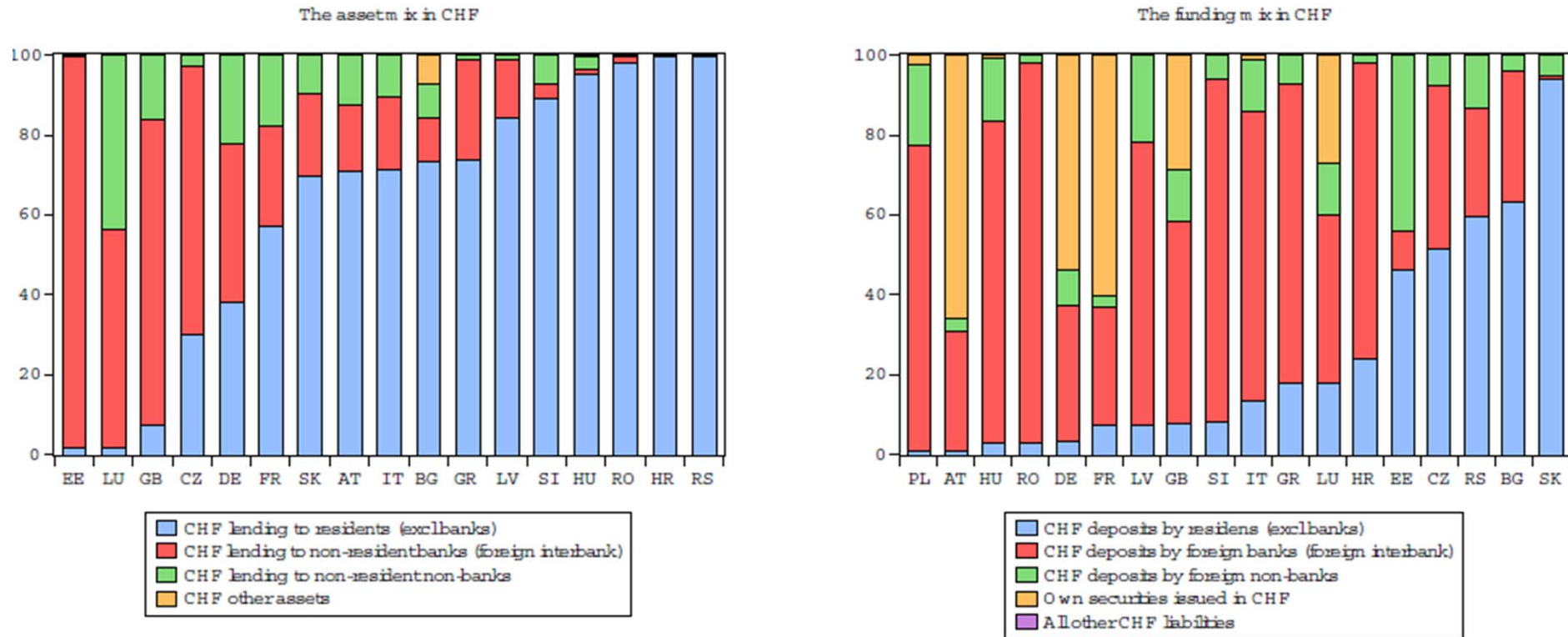


Figure 3: The composition of foreign currency positions by types or counterparties (2007-2014 average, in percent of total)

The left hand panels depicts bank foreign currency assets by counterparties or types in percent of total foreign currency assets, for Swiss francs (upper panel) and for other foreign currencies (lower panel). The right hand panels depicts the percentage of bank funding by counterparties or types in total bank funding in Swiss francs (upper panels) and in other foreign currencies (lower panel). As Austria, Czech Republic, France and Poland do not report "other assets" and "other liabilities", the bars for these countries are in percent of total assets less these missing categories. Poland does not report on foreign currency assets, and is hence excluded from the left panels. Sorted by the importance of lending to / deposits from domestic residents. Source: SNB.

Uses of other foreign currencies

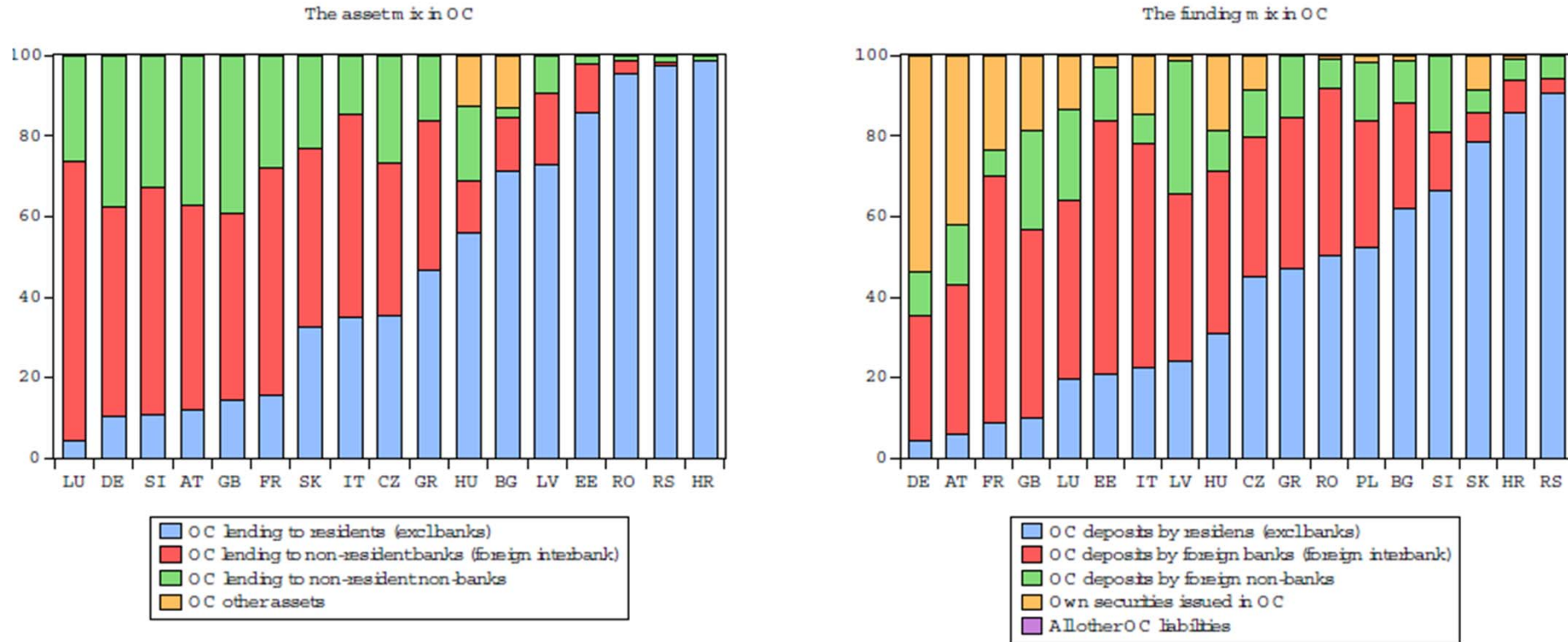


Figure 3: The composition of foreign currency positions by types or counterparties (2007-2014 average, in percent of total)

The left hand panels depicts bank foreign currency assets by counterparties or types in percent of total foreign currency assets, for Swiss francs (upper panel) and for other foreign currencies (lower panel). The right hand panels depicts the percentage of bank funding by counterparties or types in total bank funding in Swiss francs (upper panels) and in other foreign currencies (lower panel). As Austria, Czech Republic, France and Poland do not report "other assets" and "other liabilities", the bars for these countries are in percent of total assets less these missing categories. Poland does not report on foreign currency assets, and is hence excluded from the left panels. Sorted by the importance of lending to / deposits from domestic residents. Source: SNB.

Other FX funding: emerging Europe

	First Diff.	Level
Swiss M0 in % GDP	0.17	-0.43 ***
Euro M0 in % GDP	-5.56	1.62 *
US M0 in % GDP	-7.56	2.12 ***
Spread int rate on domestic and FX funding	0.02	0.01 **
FX exchange rate (+1)	-0.29 ***	0.40 ***
FX exch rate (-1) * NetExp FX (-1)	1.52	-0.69 ***
CHF exch rate (-1) * NetExpFX (-1) * NetExpCHF (-1)	3.45	-0.07
Number of observations	199	213
Number of cross sections	8	8
R-Squared	0.07	0.96

Other FX funding: emerging Europe

	First Diff.	Level
FX exch rate volatility (+1) * NetExp FX (-1)	-4.28	34.52 ***
Correl CHF and FX exch rates (+1) * NetExp CHF(-1)	0.14	-0.08 ***
Vix (-1) * NetExp FX (-1)	-2.46	0.00
Valuation adjusted CHF loans (-1)	0.64 **	-0.05
Valuation adjusted CHF deposits (-1)	-0.24	-0.06 *
Valuation adjusted FX loans (-1) * FX weights (-1)	0.75	0.40 ***
Valuation adjusted FX deposits (-1) * FX weights (-1)	-0.47	-0.35 *
Number of observations	199	213
Number of cross sections	8	8
R-Squared	0.07	0.96

Other FX funding: Euro (non centers)

	First Diff.		Level	
Swiss M0 in % GDP	2.20	**	-1.11	***
Euro M0 in % GDP	-1.06		2.41	*
US M0 in % GDP	5.17		-0.78	
Spread int rate on domestic and FX funding	0.15		0.04	
FX exchange rate (+1)	-1.06		0.57	
FX exch rate (-1) * NetExp FX (-1)	-15.65	*	0.16	**
CHF exch rate (-1) * NetExpFX (-1) * NetExpCHF (-1)	-0.22		-0.03	**
Number of observations	95		102	
Number of cross sections	4		4	
R-Squared	0.23		0.99	

Other FX funding: Euro (non centers)

	First Diff.	Level	
FX exch rate volatility (+1) * NetExp FX (-1)	-13720	-3030	**
Correl CHF and FX exch rates(+1) * NetExp CHF(-1)	-0.06	0.01	
Vix (-1) * NetExp FX (-1)	-6.02	0.00	
Valuation adjusted CHF loans (-1)	0.17	0.11	
Valuation adjusted CHF deposits (-1)	0.09	-0.07	
Valuation adjusted FX loans (-1) * FX weights (-1)	0.49	-0.17	***
Valuation adjusted FX deposits (-1) * FX weights (-1)	0.44	0.74	***
Number of observations	95	102	
Number of cross sections	4	4	
R-Squared	0.23	0.99	

Other FX funding: Euro (financial centers)

	First Diff.	Level	
Swiss M0 in % GDP	0.43	0.33	
Euro M0 in % GDP	-5.89	-2.15	*
US M0 in % GDP	-0.82	-4.39	***
Spread int rate on domestic and FX funding	0.07	0.01	
FX exchange rate (+1)	0.42	0.01	
FX exch rate (-1) * NetExp FX (-1)	-2.23	0.01	
CHFexch rate (-1) * NetExp FX(-1) * NetExp CHF(-1)	22.44	-3.84	*
Number of observations	76	82	
Number of cross sections	4	4	
R-Squared	0.15	0.99	

Other FX funding: Euro (financial centers)

	First Diff.	Level	
FX exch rate volatility (+1) * NetExp FX (-1)	1658	-9643	*
Correl CHF and FX exch rates (+1) * NetExp CHF(-1)	-0.08	-0.08	
Vix (-1) * NetExp FX (-1)	0.00	0.01	
Valuation adjusted CHF loans (-1)	0.02	-0.12	**
Valuation adjusted CHF deposits (-1)	-0.04	-0.10	**
Valuation adjusted FX loans (-1) * FX weights (-1)	-0.09	0.04	
Valuation adjusted FX deposits (-1) * FX weights (-1)	0.01	0.17	
Number of observations	76	82	
Number of cross sections	4	4	
R-Squared	0.15	0.99	