The 3rd BIS-CGFS workshop on Research on Global Financial Stability: the use of BIS International Banking and Financial Statistics
Basel, 7 May 2016

Asynchronous Monetary Policies and International Dollar Credit

Dong He*, Eric Wong#, Andrew Tsang#, Kelvin Ho#

***International Monetary Fund**

and

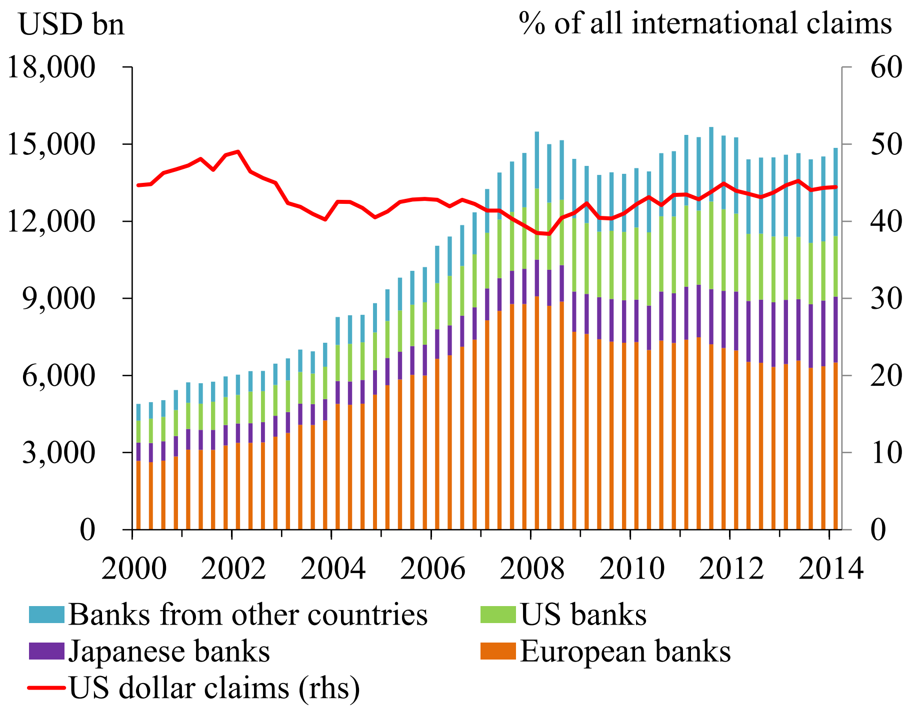
#Hong Kong Monetary Authority

The views and analysis expressed in this presentation are those of the authors, and do not necessarily reflect those of the International Monetary Fund or the Hong Kong Monetary Authority

Background

US dollar as the premier currency and the key role of European and Japanese banks in channelling international dollar credit

US dollar international claims



Notes:

1. The claims are vis-à-vis all sectors and include interoffice claims of banks
2. US-dollar international claims include US dollar cross border claims and local credit extended in US dollars in countries other than the US.
3. European banks include those in BE, FR, DE, IT, NE, ES, SE, CH and GB.

Source: BIS locational banking statistics (by nationality).

Questions

- Strong presence of European and Japanese banks in the international dollar credit market raises questions about the role of their respective home central banks relative to the US Fed in influencing global dollar liquidity.
- How does a divergence of UMPs in the US vis-à-vis the euro-area and Japan affect the supply of international dollar credit?
- In theory, EU and JP banks can cushion dollar liquidity by channelling their ample home-currency liquidity through FX swap markets. What is the net impact?
- How crucial are the functioning of the FX swap market and banks' default risk?

This study

- This study attempts to shed light on these issues both theoretically and empirically

Theoretical framework

- Our theoretical framework is modified from Ivashina et al. (2015)
- The framework captures the linkages between:
  - Global banks' supply of international dollar credit;
  - UMPs,
  - functioning of the FX swap market and banks' default risk
- A testable empirical equation can be derived from the model prediction

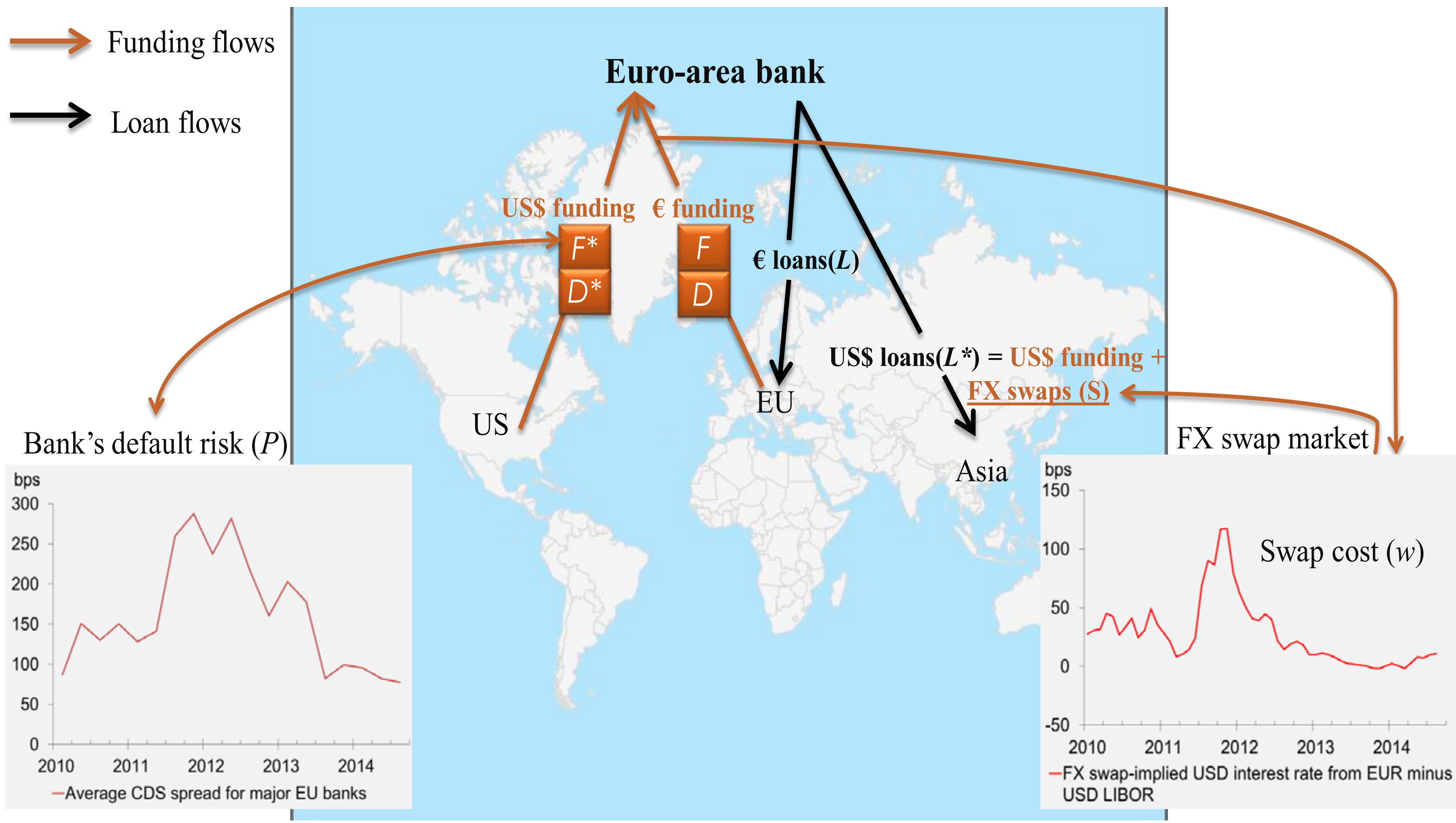
Empirical analysis

- Conduct the empirical analysis on two unique confidential datasets from the BIS and HKMA
- Follow recent studies by Ceterolli and Goldberg (2011) and Aiyar et al. (2015) to apply the fixed-effects approach to identify the impact on credit supply (Khwaja and Mian, 2008)

Findings

- Theoretical: our model highlights that UMPs both in the US and in the home country have an expansionary effect on the supply of international dollar credit.
- Empirical: this study finds that the expansionary effect of UMPs in Europe and Japan would only partially offset the contractionary effect of the US's monetary normalization on global liquidity
- The net impact is crucially dependent on whether the Fed's exit would trigger financial market disruption, particularly in the FX swap market
- Stress-testing analysis shows there remains a small risk of a notable decline in the supply of international dollar credit due to a sharp decrease in liquidity in the FX swap market when the US normalises monetary policy
- Balance sheet characteristics of global banks and business models of their overseas branches are important factors affecting the extent of international transmission of UMPs

A theoretical framework



Global bank's profit maximization problem

$$Max\{L^*, L, F^*, F, S\}: h(L) - c(F) + g(L^*) - l(F^*) - pF^* - wS \quad (1)$$

subject to two constraints:

$$L^* = D^* + F^* + S \quad (2)$$

$$L = D + F - S \quad (3)$$

Given specific functional forms for $h(L), c(F), g(L^*)$ and $l(F^*)$:

$$h(L) = \theta L - \beta \frac{L^2}{2}, \qquad g(L^*) = \theta^* L^* - \beta^* \frac{{L^*}^2}{2}$$

$$c(F) = \frac{\alpha F^2}{2}, \qquad l(F^*) = \frac{\alpha^* {F^*}^2}{2}$$

where θ, θ^*, β, β^*, α, $\alpha^*>0$

The equilibrium dollar loan can be solved and expressed as:

$$L^* = \frac{1}{\Omega} D + \frac{1}{\Omega} D^* - \frac{1}{\Omega\alpha^*} p - \frac{\alpha+\beta}{\Omega\alpha\beta} w - \frac{1}{\Omega\beta}\theta + \frac{1}{\Omega}\left(\frac{\alpha+\beta}{\alpha\beta} + \frac{1}{\alpha^*}\right)\theta^* \quad (4)$$

where

$$\Omega = \left(\frac{\alpha^*+\beta^*}{\alpha^*}\right) + \left(\frac{\alpha+\beta}{\alpha}\right)\frac{\beta^*}{\beta} > 0$$

Model prediction

Given eq.(4), $L*$ can be represented by:

$$L^* = \beta_1 D + \beta_2 D^* + \beta_3 p + \beta_4 w + \beta_5 \theta + \beta_6 \theta^* \quad (5)$$

$where\ \beta_1,\ \beta_2$ and $\beta_6 > 0;\ \beta_3,\ \beta_4$ and $\beta_5 < 0$

Factors determining international dollar credit (L*)	Model predictions
More abundant liquidity in home country ($\uparrow D$)	$\uparrow L*$
More abundant liquidity in the US ($\uparrow D^*$)	$\uparrow L*$
Higher default risk of banks ($\uparrow p$)	$\downarrow L*$
Rises in the swap cost ($\uparrow w$)	$\downarrow L*$
Increase in the demand for home-currency loans ($\uparrow \theta$)	$\downarrow L*$
Increase in the demand for US-dollar loans ($\uparrow \theta^*$)	$\uparrow L*$

Eq.(5) yields a testable empirical equation which will be carried out using two unique datasets from the BIS and the HKMA.

Data for empirical analysis

Dependent variable:

ΔL^{*}_{ijt} : quarterly growth of US dollar denominated credit to nonbank in destination country *i* by global banks in home country *j* from *t-1* to *t*

The BIS dataset for estimation **(*BIS locational statistics by nationality of bank*)**	**The HKMA dataset for estimation** **(*the return of external positions*)**
Aggregate-level data by nationality of banks	Bank-level data for foreign bank branches in Hong Kong, with parent bank data from *Bankscope*
11 non-US core global bank nationalities (BE, CA, FR, DE, IT, JP, NE, ES, SE, CH, and GB)	37 non-US foreign bank branches, accounting for 60% of total assets of foreign bank branches in HK
US-dollar denominated cross-border claims to non-bank sectors	US-dollar denominated external loans to non-bank sectors
2012Q2 – 2014Q1	2007Q1 – 2014Q2

Description of variables

Variable	Proxy	Description (Using Japanese banks as an example)
ΔL_{ijt}^{*}		Quarterly growth rate of US-dollar claims on non-banks by Japanese banks
ΔFED_t	ΔD_{jt}^{*}	Quarterly growth of the Fed's balance sheet
$US\mathrm{F}_j$		Assuming the US liquidity shock affect banks differently, depending on their reliance on funding from the US market (proxied by the ratio of total funding raised by US branch of Japanese banks to total external claims by Japan in 2012Q2).
ΔHCB_{jt}	ΔD_{jt}	Quarterly growth rate of the BOJ's balance sheet (in USD)
ΔCDS_{jt}	Δp_{jt}	The change in the average CDS spread for Japanese banks
ΔCIP_{jt-1}	$\Delta \mathrm{w}_{jt-1}$	The change in the FX swap-implied USD interest rate from Yen minus USD LIBOR
$\Delta GDP_{j,t}^{f}$	θ	Forecast of nominal GDP growth rate for Japan to control for changes in the demand for yen loans
μ_{it}	θ^{*}	Destination country-time fixed effect to account for changes in the demand for US-dollar loans

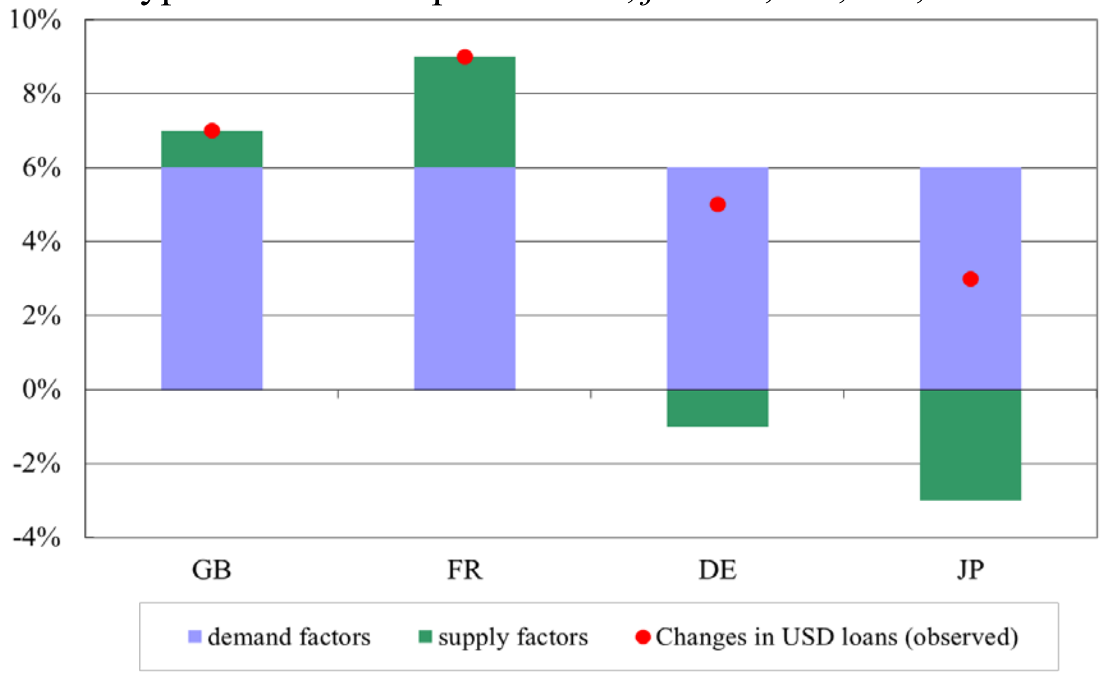
Identification strategy – fixed effects approach

$$\Delta L^*_{ijt} = \beta_1 \Delta HCB_{jt} + \beta_2 \Delta FED_t * USF_j + \beta_3 \Delta CDS_{jt} + \beta_4 \Delta CIP_{jt-1} + \beta_5 \Delta GDP_{jt} + \mu_{it} + \varepsilon_{ijt}$$

Cross-sectional differences in ΔL among global banks (green bars) are attributable to supply-side factors

Changes in demand for USD loans in destination country i should be common across global banks and thus changes in loan demand from $t\text{-}1$ to t is fully absorbed by destination country-time fixed effects (blue bars).

Hypothetical example: i = KR; j = GB, FR, DE, JP



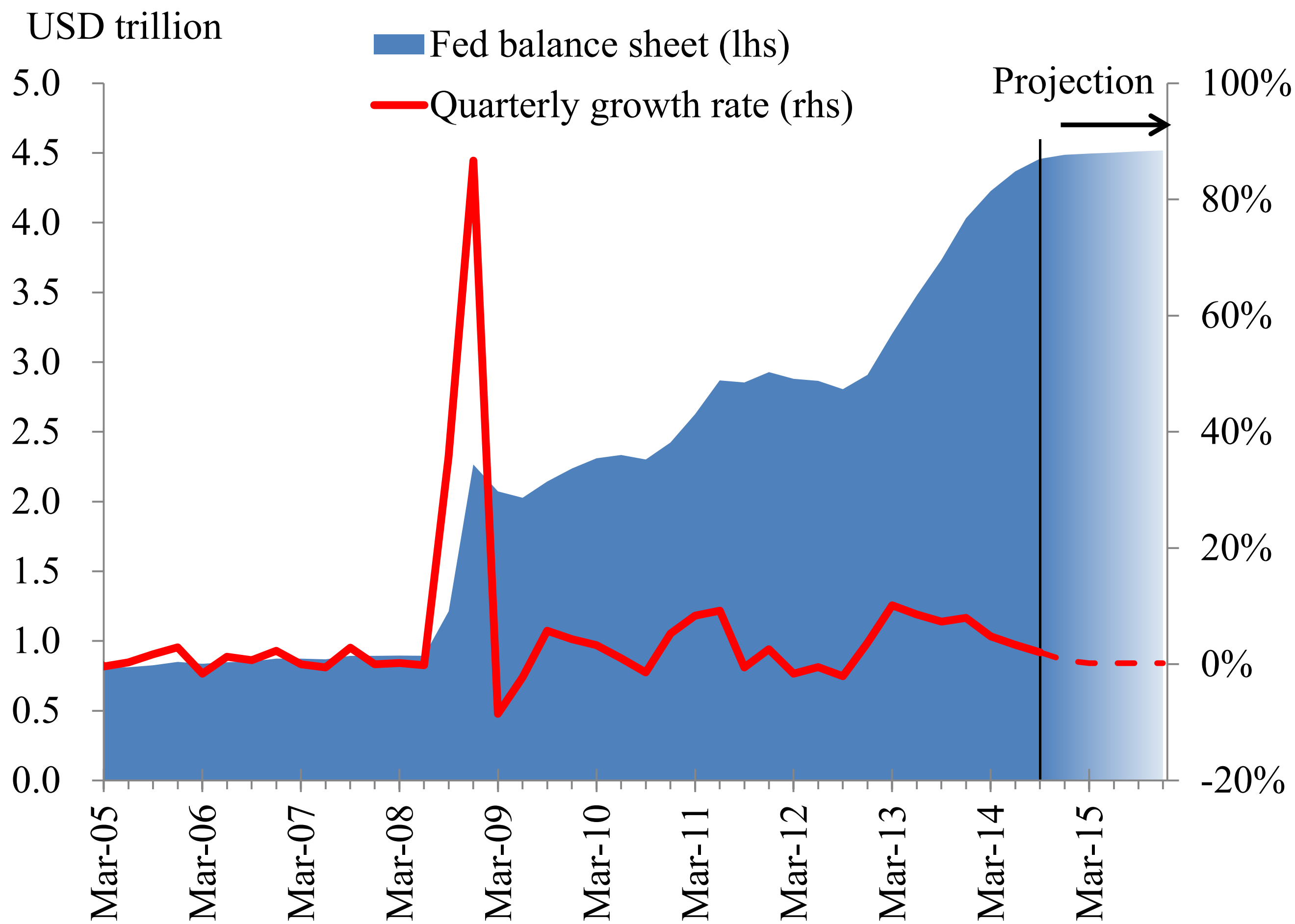
Estimation result using the BIS dataset

Variable	
ΔHCB_{jt}	0.67 ***
ΔFED_t*USF_j	5.05 ***
ΔCDS_{jt}	-8.12 *
ΔCIP_{jt-1}	-24.92 **
ΔGDP_{jt}	-3.73 ***
Country-time fixed effects for destination country *i*	
	Yes
R-squared	0.12
RMSE	0.63
No. of observations	4,577

Notes:
1. *j* = home country *j*, *i* = destination country *i*
2. Figures in parentheses are t-statistics.
3. Standard errors are clustered by home country and destination country.
4. ***, **, and * respectively indicate significance at the 1%, 5%, and 10% level

Scenario analysis:
Assumption on central banks' balance sheets

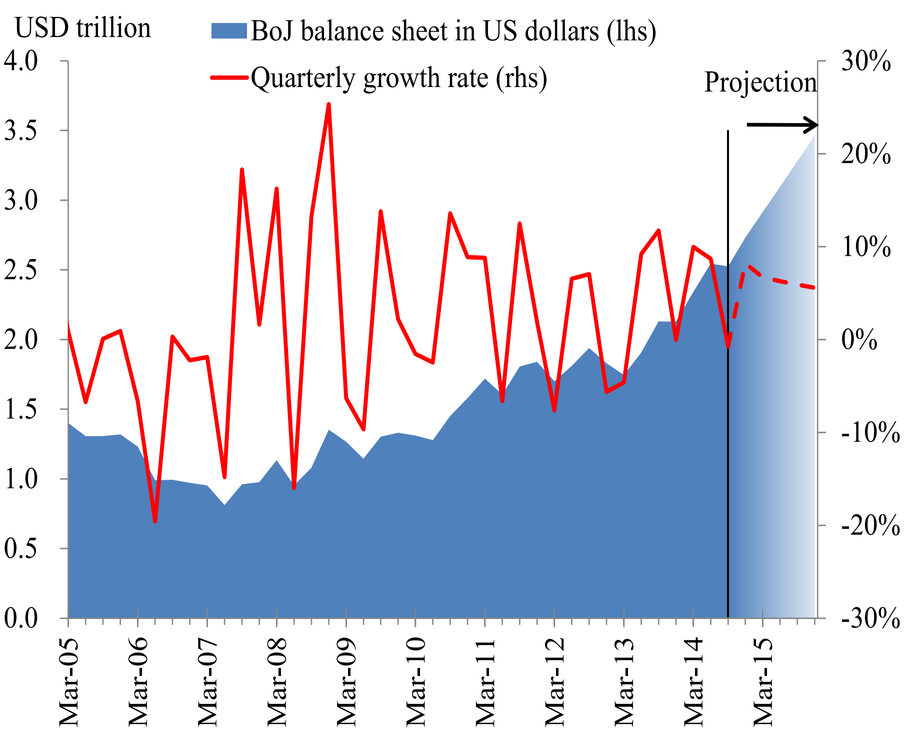
Fed's balance sheet projection



Sources: Board of Governors of the Federal Reserve System, IMF international Financial Statistics and author estimates

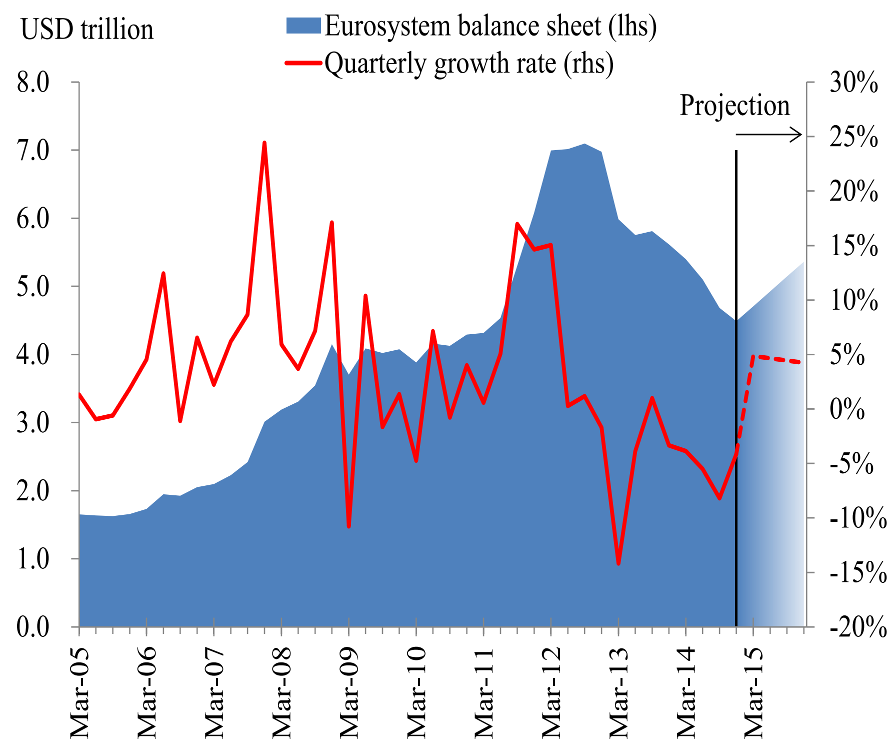
Scenario analysis:
Assumption on central banks' balance sheets

BOJ's balance sheet projection



Sources: Bank of Japan and author estimates.

Eurosystem's balance sheet projection

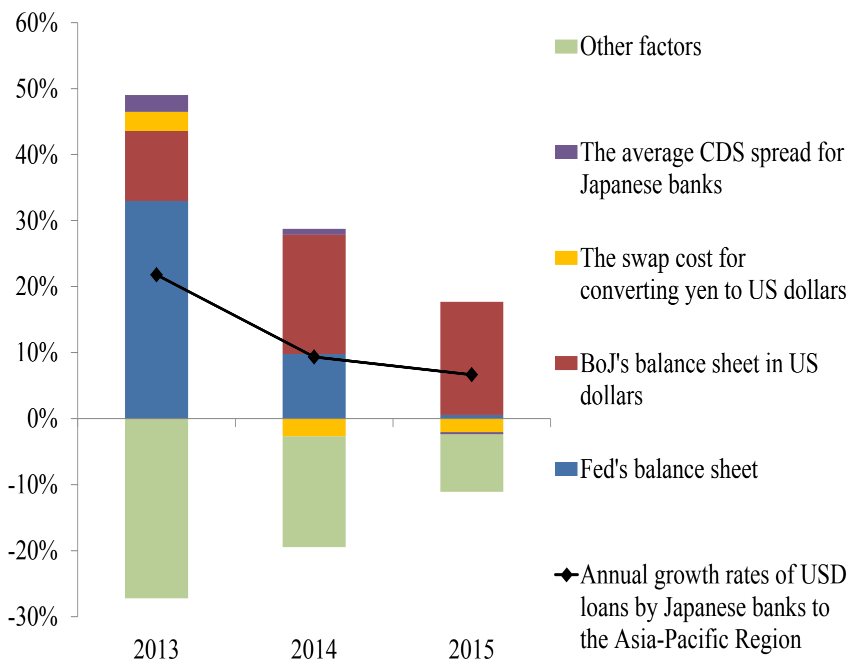


Sources: The European Central Bank and author estimates.

Scenario analysis: Baseline scenario

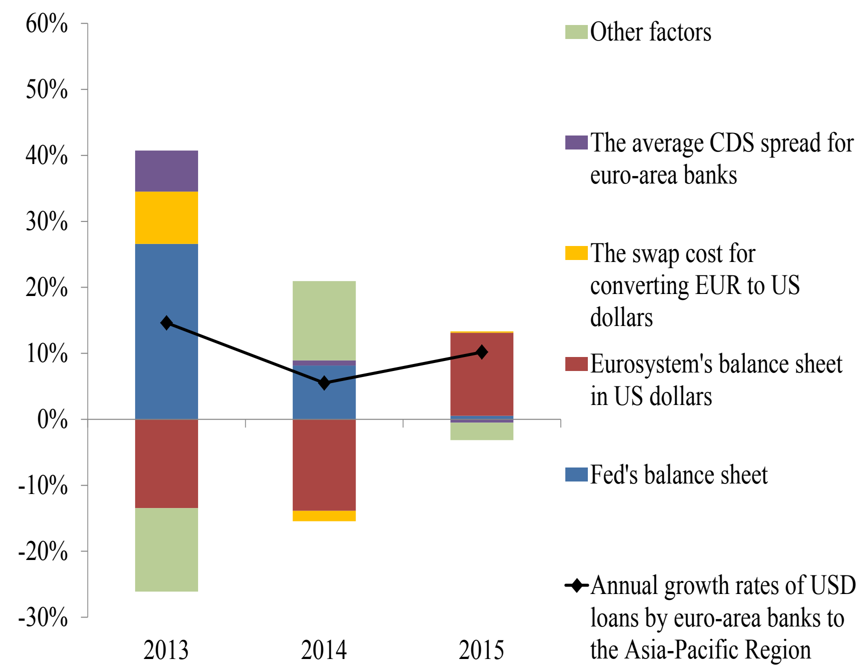
Estimated contribution by factors to the growth rate of US dollar loans of Japanese banks and euro-area banks to the Asia-Pacific region

Panel A: Japanese banks



Sources: Author estimates.

Panel B: Euro-area banks



Sources: Author estimates.

Limitation of baseline analysis

- Theoretically, the swap cost, default risk of banks and exchange rates (i.e. risk factors) may be significantly affected by UMPs, suggesting that there may be substantial indirect effects of UMPs on dollar credit, e.g.
  - Normalisation of US's UMP may reduce dollar liquidity in the FX swap market, leading to higher swap costs, and in turn could reduce the supply of international dollar credit.

- Two sets of VAR(1) models for Japanese and euro-area banks are estimated to empirically reveal the indirect effects. Specifically, for the case of Japanese banks:

$$X_t = \Phi_0 + \Phi_1 X_{t-1} + E_t$$

where

$$X_t = \begin{bmatrix} \Delta BOJ_t \\ \Delta FED_t \\ \Delta CDS_t^{JP} \\ \Delta CIP_t^{JP} \\ \Delta JPY_t \end{bmatrix} \text{ and } E_t \sim N(0, \Sigma)$$

- The model is estimated by the seemingly unrelated regression method (SUR), which takes into account the contemporaneous correlation of error terms between the variables

SUR model for Japanese banks

Variable	ΔBOJ_t	ΔFED_{t-}	ΔCDS_t^{JP}	ΔCIP_t^{JP}	ΔJPY_t
ΔBOJ_{t-1}	-0.18 **				
ΔFED_{t-1}		0.37 ***		-0.03 ***	-10.06 **
ΔCDS_{t-1}^{JP}			-0.16 *		
ΔCIP_{t-1}^{JP}				-0.87 ***	
ΔJPY_{t-1}					
Constant	0.01 ***	0.01 **	0.00	0.00 ***	0.12
R-squared	0.03	0.15	0.01	0.55	0.03
DW statistic	1.95	1.90	1.93	1.96	1.95
No. of observations	190	190	132	178	176

Notes:

1. ΔCDS_t^{JP} refers to the change in the average CDS spread for the major Japanese banks.
2. ΔCIP_t^{JP} refers to the change in the deviation from covered interest parity for converting Japanese Yen into the US dollar.
3. ΔJPY_t refers to the change in the yen/USD spot exchange rate.
4. Apart from spot exchange rate, all variables are measured in decimal points.
5. Figures in parentheses are t-statistics.
6. ***, **, and * respectively indicate significance at the 1%, 5%, and 10% level.

Stress testing analysis

- To incorporate the indirect effects
  - Risk factors are endogenously determined by the VAR model

- To estimate the tail risk: Monte Carlo simulation methods is used to estimate the expected shortfall
  - Average estimated credit growth in the worst 10% of 10,000 trails

Simulation procedures:

1. With the assumed paths for the BOJ's and the Fed's balance sheets, shocks for risk factors can be simulated using the variance-covariance matrix of the VAR model. The shocks, by construction, take into account the interrelationship between the variables

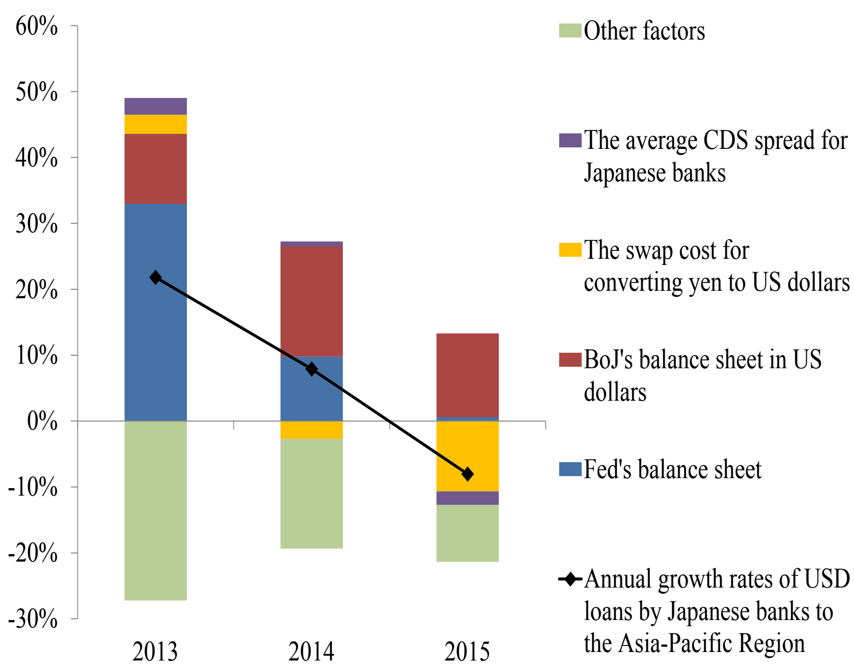
2. A simulated path for individual risk factors can be obtained using the simulated shocks and the VAR model

3. Repeats the simulation for 10,000 times. For each trail, a credit growth estimate is obtained by using the simulated values and the empirical model for international dollar credit

Scenario analysis: Stress scenario

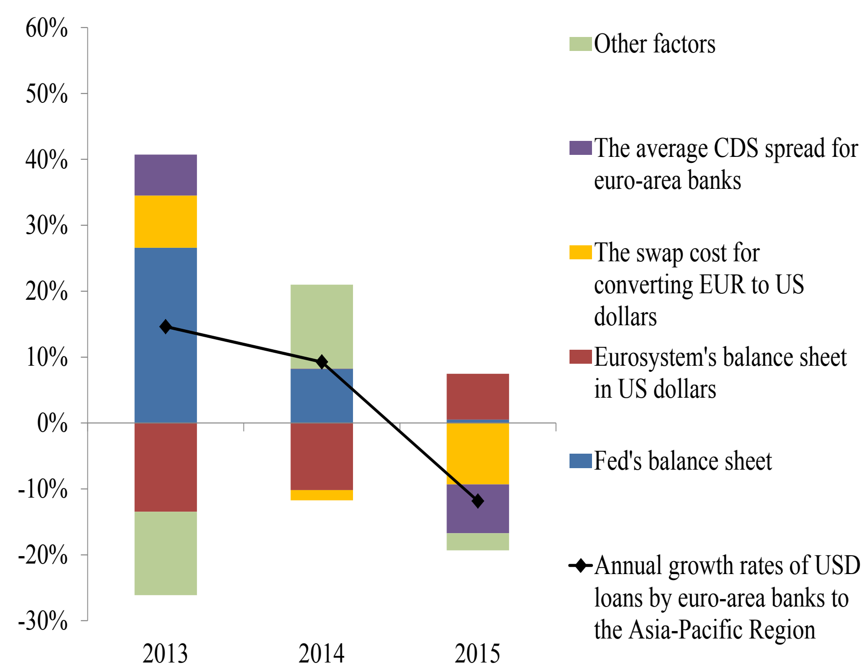
Estimated contribution by factors to the growth rate of US dollar loans of Japanese banks and euro-area banks to the Asia-Pacific region under a stress scenario

Panel A: Japanese banks



Sources: Author estimates.

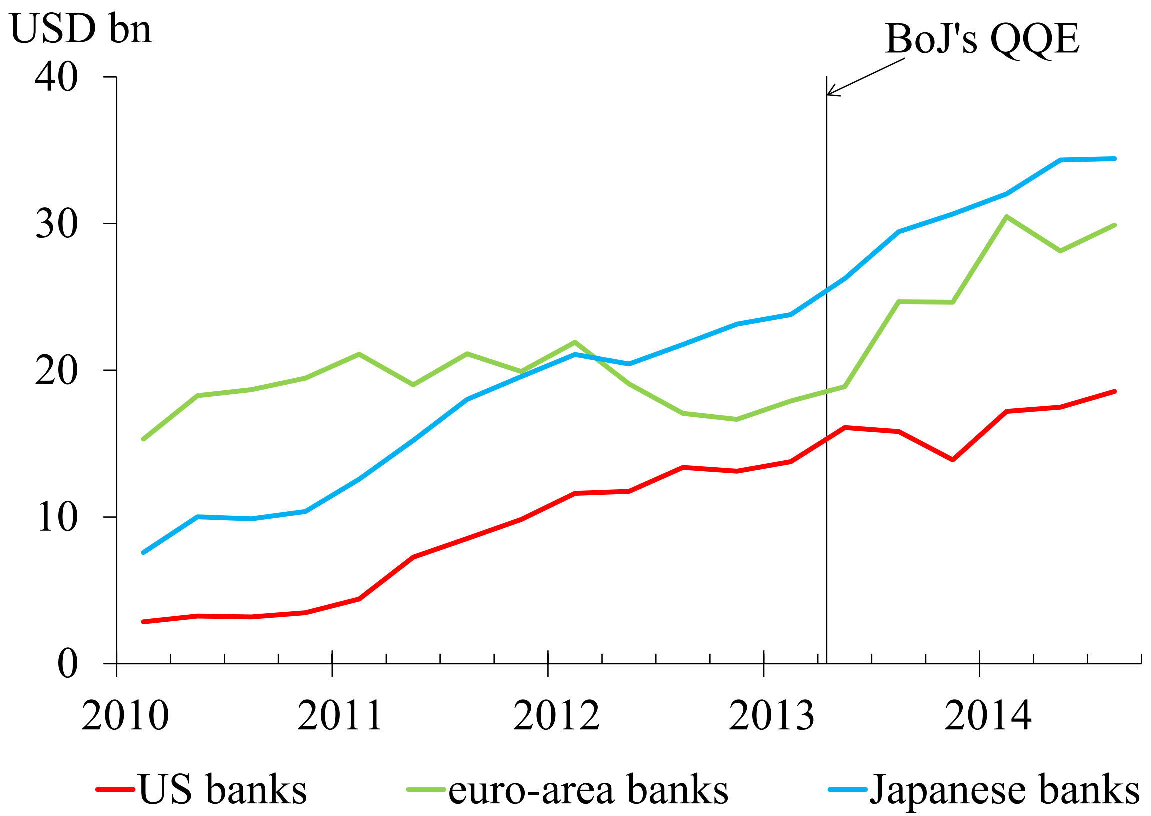
Panel B: Euro-area banks



Sources: Author estimates.

Balance sheet characteristics matter? Evidence from foreign bank branches in HK

US-dollar loans of foreign bank branches in Hong Kong by selected nationalities



Source: HKMA.

Estimation result from the HKMA dataset

Model	Model 1 Base case	Model 2 with a crisis dummy for $\Delta CIP_{i,t-1}$	Model 3 with parents' characteristics	Model 4 with branches' deposit-to-asset ratios	Model 5 Full model
ΔHCB_{jt}	0.30 **	0.31 **	0.31 **	0.33 **	0.32 **
$\Delta FED_t * USF_j$	3.15 *	3.05 *	6.53 ***	12.89 ***	10.40 ***
ΔCDS_{jt}	-9.13 **	-9.42 ***	-9.73 **	-9.28 **	-10.10 **
ΔCIP_{jt-1}	0.88	4.78	5.38	5.04	4.99
$\Delta CIP_{jt-1} * Dum(Crisis)_t$		-13.42 *	-13.60 **	-12.48 *	-12.75 *
ΔGDP_{jt}	-0.31	-0.33	-0.51	-0.55	-0.42
Risk-taking attitude: $\Delta FED_t * USF_j * Dum(low\ CAR)^P_j$			7.07 *	7.24 **	6.71 **
Asset quality: $\Delta FED_t * USF_j * PLR^P_{jt-1}$			-31.57 *	-40.29 ***	-33.35 **
Funding structure: $\Delta FED_t * USF_j * DTA^B_{jt-1}$				-22.71 **	-22.13 **
Business function: $\Delta FED_t * USF_j * LTA^B_{jt-1}$					6.65
Control variables included: (Dum(low CAR)^P, PLR^P, DTA^B, LTA^B)					
Country-time fixed effects for destination country *i*	Yes	Yes	Yes	Yes	Yes
R-squared	0.2802	0.2811	0.2830	0.2852	0.2881
RMSE	0.4414	0.4413	0.4477	0.4472	0.4465
No. of observations	2,637	2,637	2,547	2,547	2,547

Notes:
1. Some outliers of dependent variable are dropped.
2. j = home country *j*
3. Dum(low CAR) = 1 for banks with CAR at 25th percentile or below in 2006, high leverage
4. Figures in parentheses are t-statistics.
5. Standard errors are clustered by home country and destination country.
6. ***, **, and * respectively indicate significance at the 1%, 5%, and 10% level

Conclusion

- Our findings support the view that the contractionary effect of US monetary normalization on global liquidity would be partly offset by an expansionary effect from a continued supply of US dollar credit from JP and EU banks.

- However, stress testing analysis shows that even if we assume the monetary policy paths in the US, EU and JP follow their existing plans up to 2015, there remains a small risk that the supply of international dollar credit declines due to disruption in the FX swap market.

- This study finds that global banks' risk-taking attitude, credit risk exposure, and the business model of their overseas branches are important factors affecting the extent to which UMPs are transmitted internationally.

  – The financial and organisation structure of global banks plays a vital role in transmitting cross-border banking flows and therefore requires careful regulatory attention