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The asymmetric effect of international swap lines on banks in emerging markets[☆]

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ABSTRACT

This paper investigates the effect of international swap lines on stock returns using data from banks in emerging markets. The analysis first shows that swap lines by the Swiss National Bank (SNB) had a positive impact on bank stocks in Central and Eastern Europe. It then highlights the importance of individual bank characteristics in identifying the asymmetric effect of swap lines on bank stocks. Bank-level evidence suggests that stock prices of local and less-well capitalized banks as well as banks with high foreign currency exposures and high reliance on short-term funding responded more strongly to SNB swap lines. This new evidence is consistent with the view that swap lines not only enhanced market liquidity but also reduced risks associated with micro-prudential issues.

1. Introduction

In response to the global financial crisis, international swap lines between central banks of advanced economies and their counterparts in emerging market economies were introduced as a coordinated policy initiative. Empirical studies by Aizenman and Pasricha (2010), Moessner and Allen (2013), and Baba and Shim (2010) show supportive evidence that these international swap lines (hereafter, swap lines) were coincident with reductions in Covered Interest Parity (CIP) or Credit Default Swap (CDS) spreads. The country-level studies argue that swap lines prevented systemic risk and limited contagion during periods of market stress.

Although empirical studies suggest being able to identify macroprudential effects arising from swap lines, a shortcoming of the literature is its narrow focus on country-level responses to swap lines. Country-level data do not shed light on the channels through which swap lines impact banks, i.e., the beneficiaries of the foreign liquidity provision. The country-level studies assume banks are homogenous.[1] Banks however are heterogeneous in their characteristics and if specific bank characteristics matter then the response to swap lines is not expected to be uniform. In particular, it may arise that banks with high levels of foreign currency exposure benefit more from swap lines than do banks with low levels of foreign currency exposure. Alternative bank characteristics, such as banks with a weak capital structure or with a higher

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[1] For example, Goldberg et al. (2011) and Bruno and Shin (2014) acknowledge that European and Korean banks did not make equal use of liquidity provisions provided by swap lines.

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dependence on short-term funding may also matter. The literature until now has not studied whether the financial market response to swap lines observed at the country level stems from a single or a set of bank characteristics.

The objective of this paper is to examine how banks from emerging markets with different bank characteristics responded to swap lines in a period of financial market stress. The identification strategy estimates the difference-in-difference of stock prices of Hungarian and Polish banks relative to other Central and Eastern European (CEE) countries conditioning on swap lines. In particular, we focus on Swiss National Bank (SNB) swap lines with the National Bank of Poland (NBP) and the Central Bank of Hungary (MNB).[2] To identify the bank-specific response to swap lines, we examine the importance of bank characteristics. These characteristics include the level of foreign currency exposure, the funding structure, the ownership type, and the capital structure. Our hypothesis is that banks with a higher foreign currency exposure, a weaker capital structure, a local ownership structure without immediate access to foreign capital, and a financial structure based on interbank funding were frozen out from interbank markets in foreign currency during the financial crisis and thus benefited the most from the coordination of international swap lines. As such, we would expect the share price of banks with these characteristics to respond the strongest to swap lines.

The analysis considers the effect of swap lines for its entire duration from introduction to termination. Because the interbank, the foreign currency swap market, and secured money markets necessitated massive crisis intervention, cross-border coordination, and adjustments to central bank liquidity operations to stabilize the financial system and restore orderly market conditions (IMF, 2010), we argue access to the market facility of the swap line is more important than simply examining the announcement effect. Hence, we study the asymmetric response of stock prices to the period's entire duration and not simply the announcement effect of bank stocks to the swap line's introduction.

The empirical findings suggest that the effectiveness of swap lines is dependent on the structure of a country's banking system. Stock prices of local and less-well capitalized banks, as well as banks with a higher foreign currency exposure and higher reliance of short-term funding responded the strongest to the SNB swap line. This new bank-level evidence is consistent with the view that swap lines were not only important in providing liquidity but also took on micro-prudential functions.

The empirical results are presented for two levels of aggregation at the country and bank levels. We first show the country-level finding that stock returns of banks increased with SNB swap lines. This empirical result is consistent with the view that swap lines with the SNB improved liquidity conditions in CEE between 2008 and 2010. In a second stage of the analysis, the importance of bank characteristics is examined. We show that the country-level approach masks a richer set of bank-level findings.

The paper makes three contributions to the literature on unconventional measures and their impact on banks.[3] To our knowledge this is the first study to examine the impact of swap lines on banks. The new evidence on liquidity provision in emerging markets shows that stock prices of domestic and less-well capitalized banks respond strongly to SNB swap lines.[4]

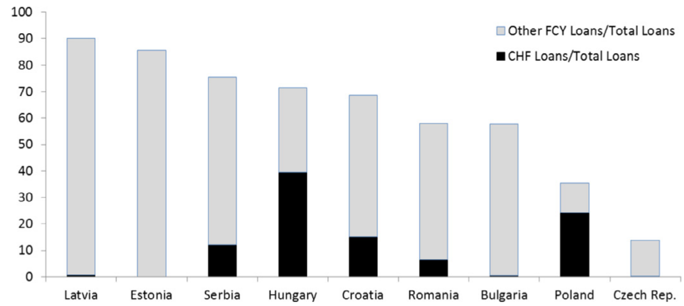

Fig. 1. Share of foreign currency loans as a percentage of total loans in the non banking sector in Eastern Europe as of 2009:Q1. Note: CHF, Swiss francs; FCY, foreign currency. Source: Swiss National Bank.

A second contribution is to show that the asymmetric response of swap lines is not dependent on currency choice. Swap lines are normally defined for exchange rates between the home currency and a major reserve currency (i.e., in U.S. dollar, euro, or yen). This, however, was not the case for swap lines between the SNB and CEE central banks. These swap line agreements were between the euro and the Swiss franc.

A third contribution shows that gains from swap lines beyond national jurisdictions were limited and/or only temporary. Only Hungarian and Polish banks benefited from swap lines between the SNB and the NBP and between the SNB and the MNB during the whole period of the swap line. The transmission of liquidity provision through swap lines does not follow the same cross border channels as liquidity shocks generated by other unconventional measures (i.e., quantitative easing).[5]

The paper is organized as follows. Section 2 reviews the motivation for SNB swap lines with the MNB and the NBP. Section 3 presents the empirical methodology. Section 4 discusses the data. Section 5 presents the empirical results. Section 6 concludes.

2. SNB swap lines and CEE banks

Swiss franc and other foreign currency loans to the non-banking sector were extremely popular in CEE before the financial crisis.[6] Households and small firms increasingly borrowed in a lower-yielding foreign currency to finance their mortgages or business investments. The shaded columns in Fig. 1 show the share of foreign currency loans as a percentage of total loans to the non-banking sector in select CEE countries for 2009:Q1.[7] Fig. 1 shows that at the height of the financial crisis, the majority of the outstanding loans to the non-banking sector in several CEE countries was denominated in foreign currency. The same figure also illustrates that Swiss franc loans were particularly popular in Hungary, Poland, Croatia, Serbia, and Romania. In the remaining countries, euro loans probably comprised the vast share of foreign currency loans.

[2] The experience in CEE before the financial crisis, particularly in Hungary and Poland, is overshadowed by the rapid growth of residential mortgage loans denominated in Swiss francs. The problem of currency mismatches became acute after the Swiss franc appreciated strongly during the financial crisis and many CEE banks were excluded from the interbank market for Swiss francs.

[3] Our paper is closest in spirit to Chodorow-Reich (2014) and Alfaro et al. (2014). The study by Chodorow-Reich (2014) investigates the impact of FOMC announcements on CDS spreads, bond yields and equity prices of financial institutions. Similarly, the paper by Alfaro et al. (2014) examines the impact of Brazilian capital controls on stock prices of Brazilian firms.

[4] For the literature on swap lines and emerging markets see, Aizenman and Pasricha (2010), Baba and Shim (2010), and Bruno and Shin (2014).

[5] For example, studies by Fratzscher et al. (2013) and Bauer and Neely (2014) show that liquidity shocks arising from asset purchases in advanced countries have spillover effects for emerging market economies.

[6] Auer and Kraenzlin (2011), Beer et al. (2010), and Yesin (2013) discuss in detail Swiss franc lending in CEE. Brown and de Haas (2012), Brown et al. (2011), and Brown et al. (2014) study the determinants of FX lending in CEE.

[7] The date 2009:Q1 is the first available observation from the CHF Lending Monitor, an ongoing project of the Swiss National Bank with the aim to understand the scope of Swiss franc lending in Europe.

Fig. 2. Balances from EUR/CHF swap operations. Note: in millions CHF Source: Swiss National Bank.

As the financial crisis escalated so did the funding tensions in Swiss francs for many CEE banks. The interbank market for Swiss francs, which funded a large share of the CEE bank activities, was impaired. Further, most CEE banks lacked access to a Swiss franc-denominated deposit base or the domestic operations of the SNB (the SNB accepts non-domestic banks as counterparties). This situation of market stress reduced credit lines for Swiss francs to CEE.

In this context, the SNB entered into temporary swap line agreements with several central banks between 2008 and 2010. Their objective was to improve the liquidity conditions for the Swiss franc in international financial markets. Table 1 lists the major swap line agreements involving the SNB. The most relevant SNB swap line agreements for this study are shaded grey in Table 1. These agreements were with the European Central Bank (ECB), the NBP, and the MNB.

The first agreement between the SNB and the ECB was a weekly swap line beginning on October 20, 2008. This swap line was euros for Swiss francs with no pre-specified limit. The objective was to provide Swiss franc funding to banks in the euro area jurisdiction.

A second swap line agreement between the SNB and the NBP began on November 17, 2008. The NBP joined the weekly EUR/CHF swap auctions between the SNB and the ECB. Under this agreement, the SNB provided the NBP with Swiss francs against euros, while the NBP provided Swiss francs to its counterparties and received Polish zlotys.

A third swap line agreement between the SNB and MNB began on February 2, 2009. The terms and conditions were similar to the previous agreements with the ECB and the NBP.[8] On January 18, 2010, it was communicated that the last EUR/CHF swap operation with the ECB, the NBP, and the MNB would be on January 25, 2010. Fig. 2 shows swap volumes between the euro and the Swiss franc for the three SNB swap agreements with the ECB, the MNP, and the NBP. Positive values reflect borrowing of Swiss francs by foreign central banks. The aggregate position is shown because the SNB did not publish separately volumes for the three central banks.[9] The figure shows a growing demand for Swiss francs with a peak volume of 62 billion CHF in March 2009. Thereafter, the volume drifts towards zero before the end of 2009.

A further swap line agreement designed to extend Swiss franc liquidity was the temporary reciprocal currency arrangements between the Federal Reserve (FED), the ECB, the Bank of England (BoE), the Bank of Japan (BoJ), and the SNB. These agreements were announced on April 6, 2009 and were terminated on February 1, 2010. Although this swap line was not actively used, it will be considered in the empirical analysis.

3. The empirical setup

The analysis of the stock price response of CEE banks to SNB swap lines is conducted at the country and bank levels. The country-level regressions begins in the spirit of Aizenman and Pasricha (2010) and Bruno and Shin (2014), which study the impact of Federal Reserve swaps on interest rates in emerging markets. Thus our first regression tests the hypothesis that swap lines improve liquidity conditions and this improvement is reflected in higher stock prices for banks in countries with swap lines. The empirical specification is as follows:

$$\begin{aligned} R_{i,j,t} = {} & \beta_1 \times SWAP_{jt}^{SNB|X} + \beta_2 \times Date_t^{SNB|X} + \Sigma_{1=k}^{K} \alpha_k R_{i,j,t-k} \\ & + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}, \end{aligned} \tag{1}$$

where $R_{i,\,j,\,t}$ denotes the bank performance measured as the change in the ln share price of a CEE bank i in country j at time t. The dummy variable, $SWAP_{jt}^{SNB|X}$, is the interaction term $Date_t^{SNB|X} \times Country_j^{SNB|X}$ used in Aizenman and Pasricha (2010) and Bruno and Shin (2014) and is $+1$ for the period and country when the swap lines with central bank X in country j are active and 0 otherwise. The dummy variable, $Date_t^{SNB|X}$, is $+1$ for the period when the swap lines with country or group X are active and 0 otherwise. The country dummy variable, $Country_j^{SNB|X}$, is $+1$ for country j in which the SNB had a swap line with central bank X and 0 otherwise. This dummy variable is not included separately because the regression includes country fixed effects. The variable, $Other_t$, captures (macroeconomic) control variables. These controls include the VIX uncertainty variable, the EMBIG spread, the one-day return of the EUR/CHF exchange rate, and the STOXX Europe 600 banks index return in t. The regression equation also includes lagged dependent variables. We include country fixed effects ν_j and time (quarter) fixed effects μ_q in all specifications to control for omitted variables. The residual is denoted by $\varepsilon_{i,\,j,\,t}$.

The SNB was involved in five separate swap line agreements, therefore their impact on stock prices of CEE banks is estimated separately. The following swap line dummies are considered: SNB-ECB swap line, $SWAP_{jt}^{SNB|ECB}$; SNB-NBP swap line, $SWAP_{jt}^{SNB|NBP}$; SNB-MNB swap line, $SWAP_{jt}^{SNB|MNB}$; joint dummy NBP and MNB, $SWAP_{jt}^{SNB|CEE}$; the multilateral swap line between the Fed, the BoJ, the ECB, the BoE, and the SNB in USD, $SWAP_{jt}^{SNB|MULT1}$; and the multilateral swap line between the SNB, the ECB, the Fed, and the BoE in reciprocal currencies, $SWAP_{jt}^{SNB|MULT2}$. The time periods of the swap line agreements are listed in Table 1.

Our variable of interest is $SWAP_{jt}^{SNB|X}$ with the prior $\beta_1 > 0$ in Eq. (1). In other words, stock prices of CEE banks respond positively to liquidity access through swap lines. Because central banks were concerned about stigma effects and published only aggregate swap volumes at best, the market was unable to determine which banks made use of swap lines. This forces us to define periods of swap line agreements with a dummy. This practice has been used in Aizenman and Pasricha (2010), Baba and Shim (2010), Moessner and Allen (2013) and Bruno and Shin (2014), and others. Thus in our analysis in Section 5, a response effect of bank stock prices on SNB swap lines cannot be interpreted as evidence that banks made use of the Swiss franc liquidity. Rather the bank's stock price increased on the information that it had access to liquidity provisions. Hence, the timing of the swap dummies needs to be inter-

[8] An open issue is whether the SNB swaps were supported by ECB cooperation agreements with the NBP and MNB. These central bank cooperations were collateralized transactions that allowed the NBP and MNB to obtain euros. ECB (2014), which reviews the history of ECB swap line agreements with other central banks during financial crisis, does not mention this.

[9] CHF volume figures are not published by the ECB, the NBP, and the MNB.

Table 1
Timeline of events (central banks' liquidity measures).

Date	Announcements	Notes	Swap line limit	Term	Start date	In place until	Dummy variable in the empirical analysis
2007							
12 December	The SNB announces USD repo auctions	The SNB announces a six-month CHF/USD swap agreement with the Federal Reserve in order to provide USD repo auctions with its counterparties.	USD 4 billion	28 days		6 months	$SWAP^{SNB\|MULT1}$
2008							
11 March	The USD/CHF swap lines are increased		USD 6 billion	28 days			
2 May	The USD/CHF swap lines are increased	Also the frequency of USD repo auctions is increased to every 2 weeks.	USD 12 billion	28 days			
30 July	The SNB announces extended-term USD repo auctions		USD 12 billion	28-days or 84 days			
18 September	The SNB announces overnight USD repo auctions. USD/CHF swap lines are also increased.		USD 27 billion	Overnight, 28-days and 84 days			
26 September	The SNB announces 7 day USD repo auctions. USD/CHF swap lines are also increased.		USD 30 billion	Overnight, 7 days, 28 days and 84 days			
29 September	USD/CHF swap lines are increased	Joint announcement of the Federal Reserve, ECB, SNB, BoC, BoE, BoJ, Danmarks Nationalbank, Norges Bank, RBA, and Sveriges Riksbank.	USD 60 billion	Overnight, 7 days, 28 days and 84 days		April 30, 2009	
13 October	USD/CHF swap lines are increased to accommodate whatever quantity of USD funding is demanded.	Joint announcement of the ECB, BoE, BoJ, SNB and the Federal Reserve	No limit	7 days, 28 days and 84 days			
15 October	The SNB and ECB announce the establishment of weekly EUR/CHF swap operations.	Starting on 20 October. In place as long as needed, but at least until January 2009	No pre-specified limit		20 October 2008	January 2009	$SWAP^{SNB\|ECB}$
7 November	The Swiss National Bank and Narodowy Bank Polski announce the establishment of weekly EUR/CHF swap operations.	Starting on 17 November 2008, the NBP will join the weekly EUR/CHF foreign exchange swap operations of the SNB and the Eurosystem. Under this arrangement, the SNB will provide the NBP with Swiss francs against euro, while the NBP will provide the Swiss francs to its counterparties against Polish zloty. In place as long as needed, but at least until January 2009.	No pre-specified limit	7 days Longer term transactions may be offered from time to time	17 November 2008	January 2009	$SWAP^{SNB\|NBP}$
19 December	USD repo auction schedule is announced for the first quarter of 2009	Joint announcement of the SNB, BoE, ECB, BoJ, and the Federal Reserve.	No limit	7 days, 28 days, 84 days			
2009							
16 January	The SNB, the ECB and the NBP announce the continuation of EUR/CHF swap operations	The goal is to support further improvements in the short-term Swiss franc money markets	No pre-specified limit	7 days	continuing	30 April 2009	

(*continued on next page*)

Table 1 (*continued*)

Date	Announcements	Notes	Swap line limit	Term	Start date	In place until	Dummy variable in the empirical analysis
28 January	The SNB and Magyar Nemzeti Bank announce the establishment of weekly EUR/CHF swap operations.	Starting on February 2, the SNB will provide the MNB with Swiss francs against euro.	No pre-specified limit	7 days	2 February 2009	30 April 2009	$SWAP^{SNB\|MNB}$
6 April	The Bank of England, the ECB, the US Federal Reserve, the Bank of Japan and the SNB announce swap arrangements	The new swap line mirrors the existing arrangement that enables the SNB to draw US dollars against Swiss francs. The Fed can draw Swiss franc liquidity against US dollars when needed.	CHF 40 billion			30 October 2009	$SWAP^{SNB\|MULT2}$
25 June	The SNB, the ECB, the Narodowy Bank Polski and the Magyar Nemzeti Bank jointly announce the continuation of the EUR/CHF swap operations		No pre-specified limit	7 days	continuing	31 October 2009	
25 June	The temporary reciprocal currency arrangements (swap lines) between the Federal Reserve and other central banks, including the Swiss National Bank, have been extended through 1 February 2010.	Bank of England, European Central Bank, Federal Reserve System, Bank of Japan.				1 February 2010	
24 September	The SNB, the ECB, the Narodowy Bank Polski and the Magyar Nemzeti Bank jointly announce the continuation of the EUR/CHF swap operations		No pre-specified limit	7 days	continuing	31 January 2010	
2010							
18 January	The SNB, the ECB, the Narodowy Bank Polski and the Magyar Nemzeti Bank announce the discontinuation of the EUR/CHF swaps operations	Demand for liquidity provided by this type of operation has declined, and conditions in the Swiss franc funding market have improved. The last swap operation will therefore be conducted on 25 January2010. Banks domiciled in Switzerland and abroad continue to have access to Swiss franc liquidity via the Swiss franc repo system and the interbank market.				25 January 2010	
27 January	The SNB confirms the expiration, on 1 February 2010, of its temporary reciprocal currency arrangements (swap lines) with the US Federal Reserve.	In this context, the SNB, in agreement with the Federal Reserve, the European Central Bank, the Bank of England and the Bank of Japan, will discontinue its US dollar repo operations with effect from 31 January 2010.					

Source: SNB press releases.

preted as defining periods of liquidity access when financial markets were under stress and not as a volume effect.[10]

The second part of our analysis relaxes the assumption that financial markets responded uniformly to swap lines. Our objective is to allow for structural features of CEE banks affect the response to liquidity access via the swap line.

Therefore, the baseline specification defined by Eq. (1) is extended to include information for bank *i*. The bank-level regression equation takes the following form:

$$R_{i,j,t} = \beta_1 \times SWAP_{jt}^{SNB|CEE} + \beta_2 \times Bank_{i,j,t}^{char} + \beta_3 \times SWAP_{jt}^{SNB|CEE} * Bank_{i,j,t}^{char} + \Sigma_{1=k}^{K}\alpha_k R_{i,j,t-k} + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}. \quad (2)$$

The variable, $Bank_{i,j,t}^{char}$, captures bank specific information: information on the bank's foreign currency exposure, funding structure, ownership type, and capital structure. Our test is the interaction term between the swap line dummy and bank specific information, $SWAP_{jt}^{SNB|CEE} * Bank_{i,j,t}^{char}$. If the interaction term is significant and positive, then this statistical evidence is consistent with the view that individual banks with particular characteristics benefitted from swap lines more than the country average. Such evidence also suggests that banks did not respond uniformly to liquidity provision.

Below four propositions that condition on bank characteristics are discussed in terms of their stock price responses to swap lines.

Proposition 1. *Banks with high levels of foreign currency exposure benefit more from swap lines than do banks with low levels of foreign currency exposure.*

The assumption is that banks with (long-term) foreign denominated assets are unable to refinance their (short-term) foreign currency liabilities during periods of financial market stress. Because many financial markets for foreign currency (i.e., Libor, national interbank market) were impaired during the financial crisis, swap lines served the function of liquidity provision. Therefore, we expect stock prices of banks with high levels of foreign currency loans to respond positively to liquidity access through swap lines.

Proposition 2. *Banks with a higher dependence on short-term funding are more reliant on swap lines.*

This proposition says that a bank's funding structure matters when markets are impaired. The crisis has clearly exposed the dangers of a bank's excessive reliance on wholesale funding (Demirgüç-Kunt and Huizinga, 2010; and Huang and Ratnovski, 2011) and previous studies showed that banks with excessive short-term funding ratios are typically more vulnerable to market conditions and liquidity risk (López–Espinosa et al., 2012). Under Proposition 2, stock prices of banks with a high reliance on the interbank market are expected to respond positively to swap lines.

Proposition 3. *Foreign owned banks are less reliant on swap lines than are domestic banks.*

The proposition says that the response of bank stocks depends on bank ownership and their interconnectedness with foreign parent banks. This proposition is also consistent with Bruno and Shin (2014). The proposition highlights the view that foreign owned banks enjoy access to secure foreign currency lines through their parent bank. However, domestic banks are liquidity constrained when local interbank markets are impaired. This means stock prices of domestically owned banks should respond more strongly to swap lines than stocks of foreign owned banks.

[10] The empirical section also considered the signalling effect associated with the swap line announcement dates. These results are discussed in the empirical section.

Proposition 4. *Banks with a weak capital structure are reliant on swap lines.*

Swap lines act as a lifeline in that they allow (distressed) banks that suffer from counterparty risk time to find new (foreign denominated) liquidity. Considering that previous studies showed that capital enhances the performance of banks during banking crises (Berger and Bouwman, 2013; Demirgüç-Kunt et al., 2013), banks with a higher capital base should be less reliant on swap lines. In this case, the swap line takes on a financial stability function in that they are providing liquidity to less-well capitalized banks.

4. Data

The dataset comprises balance sheet information for 47 commercial banks operating in 15 CEE countries from January 3, 2005 to December 31, 2012.[11] The data set is constructed in the following manner. We start with all available banks in the Bankscope database. BankScope collects data on 92 publicly traded commercial banks from CEE in 2012, but only for 64 have detailed financial information for at least 5 years. We then exclude banks for which Thomson Reuters Datastream did not provide data for stock prices. Also, hand-collected information on FX risk for each bank for each year from the bank's annual reports and financial statements is available for 47 banks. Of these 47 banks, 18 are local (domestically owned) banks and 29 are foreign-owned banks.[12] Appendix A lists the banks in our sample.

In order to assess the stock price response of Hungarian and Polish banks controlling for bank specific characteristics, we consider the following four categories of bank characteristics: a) the level of foreign currency exposure; b) the funding structure; c) the ownership type (i.e., foreign or domestic control); and d) the capital structure.

Following previous studies on foreign currency borrowing (see Basso et al., 2011; Fidrmuc et al., 2013; Luca and Petrova, 2008), we use six measures of foreign currency exposure to test Proposition 1: the share of assets in CHF measured as the ratio of assets in CHF to total assets; the share of assets in foreign currencies measured as the ratio of total assets in foreign currencies to total assets; the net position in CHF measured as the ratio of assets in CHF minus liabilities in CHF to total assets; the net position in foreign currencies measured as the ratio of total assets in foreign currencies minus total liabilities in foreign currencies to total assets; the share of liabilities in CHF measured as the ratio of liabilities in CHF to total liabilities; the share of liabilities in foreign currencies measured as the ratio of total liabilities in foreign currencies to total liabilities.

The second bank characteristic is the bank's funding structure used to test Proposition 2. Following Demirgüç-Kunt and Huizinga (2010), Ivashina and Scharfstein (2010), Altunbas et al. (2011) and Beltratti and Stulz (2012), we define funding fragility as the ratio between the sum of deposits from other banks, other deposits, and short-term borrowing over total deposits plus money market and short-term funding.

[11] The countries are Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia, and Ukraine.

[12] As in Claessens and van Horen (2014), we classify banks into foreign and local banks depending on whether 50% or more of the bank's stocks are owned by foreigners or by central, local governments or domestic private actors. Across CEE countries, foreign ownership in the banking sector has grown dramatically in the recent decade, and by 2008, foreign banks controlled around 80% of the assets in the regions banking industry. Western banks such as Raiffeisen Bank International, Erste Bank, UniCredit, Intesa, KBC, or regional banks such as OTP and NLB, are a dominant force in CEE (EIB, 2013). In our sample, 18 banks are subsidiaries of an International Banking Group with a large exposure to a region (at least 5 subsidiaries in CEE region).

The third bank characteristic is foreign ownership and international connectedness used to test Proposition 3. Foreign ownership is defined as a dummy variable to be + 1 if 50% or more of banks stocks are foreign owned (Claessens and van Horen, 2014), otherwise 0. International connectedness is defined by membership in a banking group. It is a dummy variable + 1 if the bank is a subsidiary of an international banking group with at least 5 subsidiaries in the CEE region, otherwise 0. This dummy measures the role of international connectedness without an explicit structure for ownership type.

The fourth bank characteristic is the capital structure of banks used to test Proposition 4. As in Demirgüç–Kunt et al., (2013), two measures of capital structure are used. The first variable is $CAP1_{ijt}$, which is the total capital ratio (the risk-adjusted regulatory capital ratio) calculated according to Basel rules. It is the sum of Tier 1 and Tier 2 capital divided by risk-adjusted assets and off-balance sheet exposures. The second variable is $CAP2_{ijt}$, which is defined as Tier 1 Ratio. It is calculated as Tier 1 divided by risk-adjusted assets and off-balance sheet exposures.[13]

To isolate the impact of swap lines on stock returns of CEE banks, four control variables are considered.[14] The first variable is the VIX index of implied volatility in S&P500 index options. The VIX index reflects aggregate financial market volatility, as well as the price of market volatility, see Adrian and Shin (2010). Higher market uncertainty should be negatively correlated with the return in bank stocks. The second control variable is the EMBIG spread that measures the risk aversion towards emerging markets (Everaert et al., 2015). A higher EMBIG spread should determine a decrease of the bank stocks return as this indicator reflects the global perceptions of risks in emerging market countries. The third control variable is the one-day return of the EUR/CHF exchange rate. A depreciation of the Swiss franc should help support stock prices. The fourth control variable is the STOXX Europe 600 banks index return.[15] The coefficient of this variable is expected to be positively correlated with the return of share prices for individual banks. Appendix B reports definitions and sources of all variables, whereas Appendix C exhibits the correlation matrix.

Table 2 provides summary statistics of the variables used in our analysis. Panel A reports average annual and average daily stock returns by year, whereas Panel B reports descriptive statistics of all variables in our specification. Panel A shows that average stock returns have been negative in 2008 and during 2010–2012. In particular, annual stock returns show high variation over time. Panel B shows that there are large differences in the min max values for all the main variables, supporting the panel structure used in the next section.

Fig. 3 shows the timing of the introduction of the two SNB swap lines and their mutual termination. The same graph also shows the stock prices of Hungarian and Polish banks versus the stock prices of banks from the rest of the CEE countries. The graph suggests that the introduction of the swap lines did not generate an immediate and persistent turn around for bank stock prices in Hungary and Poland. Further, the two series of bank stocks diverge in the second half of the period when swap line were in use. Note, this observation does not support a persistent announcement effect captured by the introduction of the swap lines. Rather the main difference between the two bank stock series is the observation that Hungarian and Polish bank stocks rose systematically during the entire duration of the swap lines, while bank stocks

[13] Tier 1 capital comprises shareholder funds and perpetual, noncumulative preference shares.

[14] We have also used other controls (Interest rate; GDP Growth; and Inflation rate), but they were insignificant and dropped from the regressions.

[15] Alternative indices (i.e., STOXX® Eastern Europe 300 Banks and local stock exchange indices) yielded similar results.

Table 2
Summary statistics.

Panel A – Stock returns of banks

Year	Daily stock return (%, average)	Annual stock return (%, average)	Country	Daily stock return (%, average)	Country	Daily stock return (%, average)
2005	0.0676	14.7881	**Bosnia and Herzegovina**	−0,0897	**Montenegro**	−0,0199
2006	0.0380	7.8019	**Bulgaria**	−0,0662	**Poland**	0,0065
2007	0.0472	11.9458	**Croatia**	−0,0798	**Romania**	−0,0395
2008	−0.2886	−68.0292	**Czech Republic**	0,0148	**Serbia**	−0,0423
2009	0.0443	11.8574	**Hungary**	−0,0320	**Slovakia**	−0,0364
2010	−0.0151	−4.0578	**Latvia**	−0,0386	**Slovenia**	−0,1978
2011	−0.1029	−29.2377	**Lithuania**	−0,0537	**Ukraine**	−0,2189
2012	−0.0382	−10.8925	**Macedonia (FYROM)**	−0,0143	**Total**	−0,0421
Total	−0.0421	−10.8691				

Panel B - Descriptive statistics of variables

Variables	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Bank performance (%)	76,139	−0.0421	2.2518	−9.5676	8.8138
Share of assets in CHF	37,036	0.1180	0.1350	0.0000	0.4441
Share of assets in foreign currencies	91,791	0.4254	0.4916	0.0079	8.3900
Net position in CHF	37,036	0.0581	0.0979	−0.0210	0.4404
Net position in foreign currencies	91,791	0.0287	0.1051	−0.3597	0.5417
Customer deposits (%)	95,961	1.5926	8.1272	0.3017	155.5450
Funding fragility (%)	96,481	36.3982	16.5901	11.9630	100.0000
Cap_struct1 (Total capital Ratio (%))	84,489	15.0315	5.1391	8.6300	41.5500
Cap_struct1 (Tier 1 Ratio (%))	58,425	13.8669	6.1704	5.5100	41.7400
VIX	94,611	21.4994	10.6145	9.8900	80.8600
EMBIG spread	98,042	283.5837	83.03963	137.59	475.82
Exchange rate (CHF/EUR) return	95,221	0.0000	0.0072	-0.0325	0.2463
European banking systems performance	98,042	−0.0002	0.0202	−0.1039	0.1746

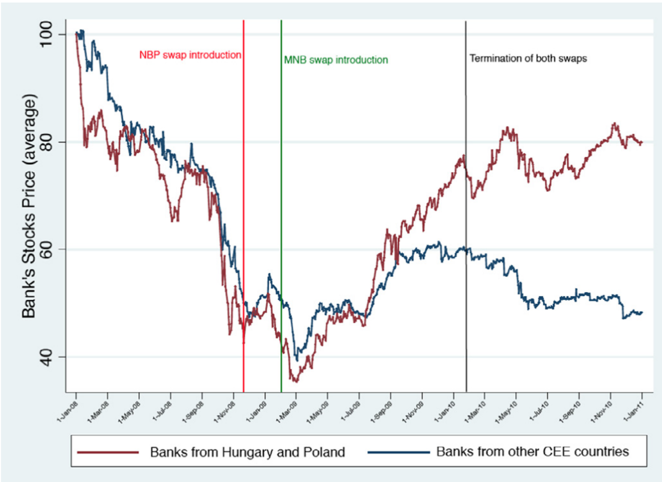

Fig. 3. Stock price development of Banks from CEE region. Source: Thomson Reuters.

from the other CEE countries were flat for the second half of the duration of the swap lines.

5. Empirical results

This section presents empirical results on the stock price response of CEE banks to SNB swap lines. The results are presented in two subsections. The first subsection documents country-level responses to swap lines. The second subsection records bank-level responses to swap lines.

The sample is from January 1, 2005 to December 31, 2012. All regressions include the VIX uncertainty variable, the EMBIG spread, the one-day return of the EUR/CHF exchange rate, and the STOXX Europe 600 banks index return, and three lags of the dependent variable as controls. In addition, country fixed effects and time (quarter) fixed effects in all specifications to control for omitted variables. Because several studies highlight the importance of clustering at the highest level of aggregation when regressors with a higher level than the dependent variable are included in the model (Wooldridge, 2003; Bertrand et al., 2004), the standard errors in all regressions control for country cluster effects.

The estimated coefficients of the control variables are consistent with their priors. The coefficient of the VIX variable is negative and highly significant. In other words, bank stock prices increase with lower uncertainty. Similarly, the coefficients of the EMBIG spread that measure the global perceptions of risks to emerging market countries is negative and significant. The coefficient of the change in the ln EUR/CHF exchange rate is positive and significant. This is also consistent with the prior that a weaker Swiss franc is coincident with an increase in bank stock prices that are exposed to currency risk. The coefficient of the European bank index return is positive and significant in all regressions. This result says that there is strong co-movement between stock prices of European and CEE banks.

5.1. Country-level responses to SNB swap lines

The country-level responses to SNB swap lines yield three empirical findings. First, stock prices of Hungarian and Polish banks responded positively to SNB swap lines with the NBP and the MNB. This finding extends the country-level results of Bruno and Shin (2014) and others using CDS and interest rate spreads for a new asset class, namely stock prices. Second, the swap line between the SNB and the ECB had no impact for CEE banks in the euro area. This result suggests that other countries in the euro area, i.e., Austria and Italy, had possibly a larger demand for Swiss francs than the CEE countries in the euro area, i.e., Slovenia and Slovakia. Third, multilateral swap lines between the SNB and major central banks had no impact on stock prices of CEE banks. In other words, CEE banks only benefitted from swap lines if their country's central bank had a swap line agreement with the SNB. This result suggests that CEE financial markets were highly segmented during periods of market stress and gains from swap lines beyond national jurisdictions were limited.

Table 3 presents regressions for Eq. (1) that include four different dummy variables which proxy different swap line agreements. Column 1 shows the (joint) swap dummy for Hungary and Poland, $SWAP_{jt}^{SNB|CEE}$, that captures periods when the SNB-NBP and/or the SNB-MNB swap lines were active in the two countries. The coefficient of the swap line agreements is 0.2154 and is statistically significant. This coefficient says that stock prices of Hungarian and Polish banks increased daily on average 0.21% more than the CEE average during the period when the swap lines were active. This is equivalent to an accumulated return of 6.71% over the period of the swap line. For completeness, we include the time dummy of the swap line, $Date_t^{SNB|CEE}$. The positive coefficient of the time dummy suggests that stock markets in CEE benefited from the introduction of SNB swap lines with the NBP and the MNB. In other words, there were potential spillovers to countries without a swap line with the SNB.

The dummy proxying the SNB-ECB swap line, $SWAP_{jt}^{SNB|ECB}$, is shown in column 2 of Table 3. The coefficient of the dummy is negative and statistically insignificant. This result is possibly explained by the fact that CEE countries in the euro area (i.e., Slovenia and Slovakia) have relatively small volumes of Swiss franc denominated loans compared to Hungary and Poland. As in column 1, the time dummy for the ECB swap line, $Date_t^{SNB|ECB}$, is positive and statistically significant.

Columns 3 and 4 test the Hungarian and Polish swap lines separately. The regressions show that both dummy variables are positive and statistically significant. The coefficients are 0.28 for Hungary and 0.17 for Poland. In both regressions, the country and date variables are significant. The time dummy variables for both swap lines are positive and statistically significant.

Next, results from robustness tests with different sample periods are shown in Table 4. We focus on the joint dummy for SNB-MNB and SNB-NBP swap lines, $SWAP_{jt}^{SNB|CEE}$. The coefficient of the variable of interest, $SWAP_{jt}^{SNB|CEE}$, is stable and significant for different sample periods. For comparative purposes, Column 1 presents the regression from the previous table for the full sample period from 2005 to 2012. Column 2 shows there is no change in the coefficient of $SWAP_{jt}^{SNB|CEE}$ after the Lehman shock. Similarly, the regression for the shortened sample that covers the Lehman shock to the Euro crisis in May 2010 shows that the coefficient for $SWAP_{jt}^{SNB|CEE}$ remains stable. The fourth sample starts March 1, 2009 (i.e., at least one month after the SNB swap lines were introduced with CEE central banks). In this regression, $SWAP_{jt}^{SNB|CEE}$ is statistically significant and economically relevant. On the other hand, the date dummy is no longer statistically significant. This result suggests that potential spillovers from swap lines outside national jurisdictions were only temporary. The positive and statistically significant results from the date dummy shown in Table 3 may be attributed to an announcement effect across CEE stock markets.

Table 5 provides a number of robustness tests of the results of Model 1 in Table 3, which are reproduced in column 1. In Model 2, we report estimates with panel-corrected standard errors (Beck and Katz, 1995). This correction controls for bank-level heteroscedasticity and an AR(1) process in the error structure. The re-

Table 3

Estimating impact of the SNB swap on Hungarian and Polish banks. This table reports the results of regressions that examine the impact of the SNB swap on Hungarian and Polish banks. We estimate alternative versions of the following regression specification:

$R_{i,j,t} = \beta_1 \times SWAP_{jt}^{SNB|X} + \beta_2 \times Date_t^{SNB|X} + \Sigma_{1=k}^{K} \alpha_k R_{i,j,t-k} + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}$

where $R_{i,\,j,\,t}$ denotes the bank performance measured as the change in the ln share price of a CEE bank i in country j at time t; the variable, $SWAP_{jt}^{SNB|X} = Date_t^{SNB|X} \times Country_j^{SNB|X}$, is + 1 for the period and country when the swap lines with country or group X are active and 0 otherwise and denotes one of the alternative dummy swap lines: SNB-CEE ($SWAP_{jt}^{SNB|CEE}$) – is a dummy variable taking a one if the bank operates in Hungary for period 2 February 2009 – 25 January 2010 or in Poland for period 17 November 2008–25 January 2010, SNB-ECB swap line ($SWAP_{jt}^{SNB|ECB}$) – is a dummy variable taking a one if the bank operates in any country member of Euro zone for period 20 October 2008–25 January 2010, SNB-MNB swap line ($SWAP_{jt}^{SNB|MNB}$) – is a dummy variable taking a one if the bank operates in Hungary for period 2 February 2009–25 January 2010, and SNB-NBP swap line ($SWAP_{jt}^{SNB|NBP}$) is a dummy variable taking a one if the bank operates in Poland for period 17 November 2008–25 January 2010; the dummy variable, $Date_t^{SNB|X}$, is + 1 for the period when the swap lines with country or group X are active and 0 otherwise; $R_{i,j,t-k}$ - lagged (k = 1, 2 and 3) values of dependent variable; the $Other_t$ captures (macroeconomic) control variables and include *VIX* – to control for investor sentiment and market volatility; *EMBIG spread* - to control for global perceptions of risks to emerging market countries; *Exchange rate (CHF/EUR) return* – to control for movements on FX markets; *European banking systems performance* (STOXX® Europe 600 Banks index return) – to control for European banking system overall performance. We include country fixed effects ν_j and time (quarter) fixed effects μ_q in all specifications to control for omitted variables. Standard errors are reported in brackets and account for clustering at the country level. We use ***, **, and * to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent: bank performance	Model 1	Model 2	Model 3	Model 4
SNB-CEE	0.2154***			
	(0.0436)			
CEE – Date	0.2683***			
	(0.0919)			
SNB-ECB		−0.0414		
		(0.0502)		
ECB – Date		0.4646***		
		(0.1438)		
SNB-MNB			0.2899***	
			(0.0623)	
MNB – Date			0.2769***	
			(0.0952)	
SNB-NBP				0.1760***
				(0.0354)
NBP – Date				0.2818***
				(0.0944)
Bank performance (Lag 1)	−7.3443**	−7.3298**	−7.3041**	−7.3334**
	(3.0969)	(3.1031)	(3.1016)	(3.0981)
Bank performance (Lag 2)	−3.1229***	−3.1106***	−3.0860***	−3.1121***
	(0.8559)	(0.8592)	(0.8570)	(0.8547)
Bank performance (Lag 3)	−1.4528*	−1.4437*	−1.4297*	−1.4428*
	(0.8396)	(0.8384)	(0.8350)	(0.8377)
VIX	−0.0274***	−0.0269***	−0.0281***	−0.0274***
	(0.0052)	(0.0052)	(0.0054)	(0.0052)
EMBIG spread	18.9306***	18.7934***	18.9974***	18.9315***
	(3.3308)	(3.3111)	(3.3348)	(3.3306)
Exchange rate (CHF/EUR) return	16.8824***	16.9073***	16.8823***	16.8820***
	(5.8953)	(5.8994)	(5.8966)	(5.8953)
European banking systems performance	−0.0033	−0.0019	−0.0034	−0.0033
	(0.0025)	(0.0023)	(0.0025)	(0.0025)
Constant	0.9764**	0.7266*	1.0088**	0.9772**
	(0.4557)	(0.4212)	(0.4584)	(0.4556)
Country FE	YES	YES	YES	YES
Time (Quarter) FE	YES	YES	YES	YES
R-squared	0.4822	0.4808	0.4793	0.4809
N. of cases	71,888	71,888	71,888	71,888
Mean of dependent variable	−0.0421	−0.0421	−0.0421	−0.0421

sults on the impact of swap line agreements on bank performance continue to hold.

In Model 3, we apply the first difference GMM of Arellano and Bond (1991). We report the outcomes of the Arellano and Bond test for autocorrelation of order 1 and 2. The p-value of 0.00 shows that we can reject the null hypothesis of no second-order autocorrelation. To test whether the instruments are valid, Hansen's J test for overidentifying restrictions is performed and unable to reject the null (p-value 0.56). We conclude that the specification under model 1 is robust to the variance considerations captured by the GMM approach.

Finally, we perform a placebo test that aims to address the issue of whether the results are driven by the exogeneity of the intervention of Swiss National Bank. We replicate the experiment for $SWAP_{jt}^{SNB|CEE}$, but we use the dummy Placebo Swap as a treatment rather than the SNB-CEE dummy. In this Placebo test, we create a Placebo Swap indicator that is a dummy variable taking the value + 1 if the bank operates in other countries with a high exposure on FX loans denominated in CHF, i.e., Croatia, Romania and Serbia, for the period from 2 February 2009 – 25 January 2010 (defined by the sample period for the SNB-NBP swap). Model 4 presents the results of this Placebo test. We observe that the Placebo test coefficient is close to zero and is not statistically significant. This suggests that the bank performance does not increase more in these countries where the Placebo swap is effective (Croatia, Romania and Serbia) compared with other countries. This result confirms our baseline results that stock prices of Hungar-

Table 4

Robustness checks with different sample periods. This table reports the results of regressions that examine the impact of the SNB swap on Hungarian and Polish banks using different sample periods. We estimate alternative versions of the following regression specification:
$R_{i,j,t} = \beta_1 \times SWAP_{jt}^{SNB|X} + \beta_2 \times Date_t^{SNB|X} + \Sigma_{1=k}^{K}\alpha_k R_{i,j,t-k} + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}$
where $R_{i,j,t}$ denotes the bank performance measured as the change in the ln share price of a CEE bank i in country j at time t; the variable, $SWAP_{jt}^{SNB|X} = Date_t^{SNB|X} \times Country_j^{SNB|X}$, is + 1 if the bank operates in Hungary for period 2 February 2009–25 January 2010 or in Poland for period 17 November 2008–25 January 2010; the dummy variable, $Date_t^{SNB|X}$, is + 1 for the period when the swap lines with Hungary (2 February 2009–25 January 2010) or Poland (17 November 2008–25 January 2010) are active and 0 otherwise; $R_{i,j,t-k}$ - lagged (k = 1, 2 and 3) values of dependent variable; the $Other_t$ captures (macroeconomic) control variables and include *VIX* – to control for investor sentiment and market volatility; *EMBIG spread* - to control for global perceptions of risks to emerging market countries; *Exchange rate (CHF/EUR) return* – to control for movements on FX markets; *EMBIG spread* - to control for global perceptions of risks to emerging market countries; *European banking systems performance* (STOXX® Europe 600 Banks index return) – to control for European banking system overall performance. In Model 2 we report estimates for the period after 15 September 2008 - Lehman Brothers files for bankruptcy. In Model 3 we report estimates for the period after 15 September 2008 - Lehman Brothers files for bankruptcy until 23 April 2010 - Greece officially requests financial support from the euro area countries and the IMF. We include country fixed effects ν_j and time (quarter) fixed effects μ_q in all specifications to control for omitted variables. Standard errors are reported in brackets and account for clustering at the country level. We use ***, **, and * to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent: bank performance	Model 1 Full sample	Model 2 After 15 Sept 2008	Model 3 Between 15 Sept 2008 and 23 Apr 2010	Model 4 30 days after the Swap dates
SNB-CEE	0.2154***	0.2139***	0.2021***	0.3234***
	(0.0436)	(0.0428)	(0.0418)	(0.0628)
CEE – Date	0.2683***	0.2754***	0.2073***	0.1407
	(0.0919)	(0.0930)	(0.0761)	(0.0985)
Bank performance (Lag 1)	−7.3443**	−6.7044**	−2.3457	−8.7002***
	(3.0969)	(3.2129)	(3.9506)	(2.9222)
Bank performance (Lag 2)	−3.1229***	−2.9445***	−1.4739	−3.3487***
	(0.8559)	(0.7942)	(0.9676)	(1.0246)
Bank performance (Lag 3)	−1.4528*	−1.5516	−0.6284	−2.4822***
	(0.8396)	(0.9988)	(1.2723)	(0.7306)
VIX	−0.0274***	−0.0237***	−0.0337***	−0.0176***
	(0.0052)	(0.0048)	(0.0099)	(0.0042)
EMBIG spread	−0.0033	−0.0031	−0.0104**	0.0002
	(0.0025)	(0.0028)	(0.0048)	(0.0026)
Exchange rate (CHF/EUR) return	18.9306***	15.4645***	37.3931***	9.1198***
	(3.3308)	(2.4043)	(10.2019)	(2.1033)
European banking systems performance	16.8824***	16.4930***	17.8654***	14.9228***
	(5.8953)	(5.6612)	(6.0530)	(5.3077)
Constant	0.9764**	1.8519	3.9084**	1.4081
	(0.4557)	(1.3277)	(1.6557)	(1.2435)
Country FE	YES	YES	YES	YES
Time (Quarter) FE	YES	YES	YES	YES
R-squared	0.4822	0.5263	0.7269	0.3983
N. of cases	71,888	48,461	17,105	44,014
Mean of dependent variable	−0.0421	−0.0554	−0.0410	−0.0676

Table 5

Robustness checks with different estimation methods. This table shows robustness tests of Model 1 in Table 3 (here repeated in model 1). Model 2 shows a specification with panel-corrected standard errors which combines bank-level heteroscedasticity with a panel-specific AR(1) process. Model 3 shows a specification using Arellano and Bond (1991) the First difference GMM. AB test AR1(2) shows the p-value of the Arellano–Bond test that average autocovariance in residuals of order 1 (order 2) is 0. Hansen J shows the p-value of the Hansen J test for overidentifying restrictions, which is asymptotically distributed as χ^2 under the null of instrument validity. Model 5 shows OLS regression estimates of the Placebo test. Lag dependent variables and the constant are not shown. We use ***, **, and * to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent: bank performance	Model 1 OLS	Model 2 PCSE	Model 3 FD-GMM	Model 4 Placebo test
SNB-CEE	0.2154***	0.1902***	0.1175***	
	(0.0436)	(0.0495)	(0.0333)	
CEE – Date	0.2683***	0.2837***	0.1336**	0.2935**
	(0.0919)	(0.0697)	(0.0641)	(0.1215)
Placebo swap				−0.0192
				(0.0207)
VIX	−0.0274***	−0.0284***	−0.0110**	−0.0276***
	(0.0052)	(0.0025)	(0.0046)	(0.0053)
EMBIG spread	−0.0033	−0.0033**	−0.0018	−0.0033
	(0.0025)	(0.0013)	(0.0011)	(0.0024)
Exchange rate (CHF/EUR) return	18.9306***	18.9198***	17.6210***	18.8295***
	(3.3308)	(1.6524)	(2.1832)	(3.3017)
European banking systems performance	16.8824***	16.7295***	17.5496***	16.9144***
	−0.0274***	−0.0284***	−0.0110**	−0.0276***
Country FE	YES	YES	YES	YES
Time (Quarter) FE	YES	YES	YES	YES
N. of cases	71,888	71,888	71,935	71,888
R-squared	0.4821	0.5131		0.4785
AB test AR(1)			0.0000	
AB test AR(2)			0.9140	
Hansen J			0.5626	
Mean of dependent variable	−0.0421	−0.0554	−0.0410	−0.0676

Table 6

Robustness checks controlling for signalling effect. This table reports the results of regressions that examine the impact of the SNB swap on Hungarian and Polish banks. We estimate alternative versions of the following regression specification:

$R_{i,j,t} = \beta_1 \times SWAP_{jt}^{SNB|X} + \beta_2 \times Date_t^{SNB|X} + \beta_3 \times SwapSignal_{jt}^{SNB|X} + \Sigma_{1=k}^{K} \alpha_k R_{i,j,t-k} + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}$

where $R_{i,j,t}$ denotes the bank performance measured as the change in the ln share price of a CEE bank i in country j at time t; the variable, $SWAP_{jt}^{SNB|X} = Date_t^{SNB|X} \times Country_j^{SNB|X}$, is +1 for the period and country when the swap lines with country or group X are active and 0 otherwise and denotes one of the alternative dummy swap lines: SNB-CEE ($SWAP_{jt}^{SNB|CEE}$) – is a dummy variable taking a one if the bank operates in Hungary for period 2 February 2009–25 January 2010 or in Poland for period 17 November 2008–25 January 2010, SNB-ECB swap line ($SWAP_{jt}^{SNB|ECB}$) – is a dummy variable taking a one if the bank operates in any country member of Euro zone for period 20 October 2008–25 January 2010, SNB-MNB swap line ($SWAP_{jt}^{SNB|MNB}$) – is a dummy variable taking a one if the bank operates in Hungary for period 2 February 2009–25 January 2010, and SNB-NBP swap line ($SWAP_{jt}^{SNB|NBP}$) is a dummy variable taking a one if the bank operates in Poland for period 17 November 2008–25 January 2010; the dummy variable, $Date_t^{SNB|X}$, is + 1 for the period when the swap lines with country or group X are active and 0 otherwise; the dummy variable, $SwapSignal_{jt}^{SNB|X}$, is a preliminary announcement dummy and take value + 1 during the period between announcement and implementation dates of swap lines and 0 otherwise (The SNB-ECB swap line was announced on Wednesday, October 15, 2008 and it became effective on Monday, October 20, 2008. The SNB-NBP swap line was announced on Friday, November 7, 2008 and it became effective on Monday, November 17, 2008. The SNB-MNB swap line was announced on Wednesday, January 28, 2009 and it became effective on Monday, February 2, 2009); $R_{i,j,t-k}$ - lagged (k = 1, 2 and 3) values of dependent variable; the $Other_t$ captures (macroeconomic) control variables and include *VIX* – to control for investor sentiment and market volatility; *EMBIG spread* - to control for global perceptions of risks to emerging market countries; *Exchange rate (CHF/EUR) return* – to control for movements on FX markets; *European banking systems performance* (STOXX® Europe 600 Banks index return) – to control for European banking system overall performance. We include country fixed effects ν_j and time (quarter) fixed effects μ_q in all specifications to control for omitted variables. Standard errors are reported in brackets and account for clustering at the country level. We use ***, **, and * to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent: bank performance	Model 1	Model 2	Model 3	Model 4
SNB-CEE	0.2156***			
	(0.0436)			
CEE – Date	0.2758***			
	(0.0946)			
SNB-ECB		−0.0421		
		(0.0508)		
ECB – Date		0.4650***		
		(0.1437)		
SNB-MNB			0.2899***	
			(0.0623)	
MNB – Date			0.2780***	
			(0.0949)	
SNB-NBP				0.1761***
				(0.0354)
NBP – Date				0.2898***
				(0.0979)
CEE – Signal	0.2917*			
	(0.1681)			
ECB – Signal		0.1492		
		(0.4804)		
MNB – Signal			0.2789*	
			(0.1538)	
NBP – Signal				0.3096*
				(0.1763)
Bank performance (Lag 1)	−7.3416**	−7.3299**	−7.3047**	−7.3299**
	(3.0992)	(3.1031)	(3.1017)	(3.1010)
Bank performance (Lag 2)	−3.1207***	−3.1104***	−3.0873***	−3.1083***
	(0.8577)	(0.8592)	(0.8576)	(0.8572)
Bank performance (Lag 3)	−1.4560*	−1.4433*	−1.4299*	−1.4461*
	(0.8375)	(0.8386)	(0.8351)	(0.8355)
VIX	−0.0274***	−0.0269***	−0.0281***	−0.0274***
	(0.0052)	(0.0052)	(0.0054)	(0.0052)
EMBIG spread	−0.0033	−0.0019	−0.0034	−0.0033
	(0.0025)	(0.0023)	(0.0025)	(0.0024)
Exchange rate (CHF/EUR) return	18.9042***	18.7956***	19.0023***	18.8977***
	(3.2994)	(3.3126)	(3.3327)	(3.2928)
European banking systems performance	16.8900***	16.9069***	16.8806***	16.8922***
	(5.9062)	(5.8993)	(5.8973)	(5.9085)
Constant	0.9743**	0.7268*	1.0088**	0.9747**
	(0.4539)	(0.4208)	(0.4584)	(0.4535)
Country FE	YES	YES	YES	YES
Time (Quarter) FE	YES	YES	YES	YES
R-squared	0.4823	0.4808	0.4793	0.4811
N. of cases	71,888	71,888	71,888	71,888
Mean of dependent variable	−0.0421	−0.0421	−0.0421	−0.0421

ian and Polish banks benefited from the introduction of SNB swap lines with the NBP and the MNB.

Table 6 considers whether a signalling (announcement) effect is captured in $SWAP_{jt}^{SNB|CEE}$. The regressions in Table 6 include an announcement dummy that corresponds to the time period between the announcement of the swap line agreements and the time when they were first effective. The regressions in Table 6 support evidence of a signalling channel. It is important to note that

Table 7
Controlling for the other major central banks' swap agreements. This table reports the results of regressions that examine the impact of the SNB swap on Hungarian and Polish banks controlling for the other major central banks' swap agreements. We estimate alternative versions of the following regression specification:
$R_{i,j,t} = \beta_1 \times SWAP_{jt}^{SNB|CEE} + \beta_2 \times SWAP_{jt}^{SNB|X} + \Sigma_{1=k}^{K}\alpha_k R_{i,j,t-k} + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}$
where $R_{i,j,t}$ denotes the bank performance measured as the change in the ln share price of a CEE bank i in country j at time t; the dummy variable, SNB-CEE ($SWAP_{jt}^{SNB|CEE}$) – is a dummy variable taking a one if the bank operates in Hungary for period 2 February 2009–25 January 2010 or in Poland for period 17 November 2008–25 January 2010; $SWAP_{jt}^{SNB|X}$, is +1 for the period when the swap lines with country or group X are active and 0 otherwise and denotes one of the alternative dummy swap lines: SNB-ECB ($SWAP_{jt}^{SNB|ECB}$) – a dummy variable taking a one if SNB has an Liquidity Swap with ECB (20 October 2008–25 January 2010); SNB-USD ($SWAP_{jt}^{SNB|MULT1}$) – a dummy variable taking a one if SNB has an Dollar Liquidity Swap Lines with FED or other banks (12 December 2007–1 February 2010; and May 2010 – 31 December 2012); and SNB-CBs ($SWAP_{jt}^{SNB|MULT2}$) - a dummy variable taking a one if SNB has an CHF Liquidity Swap Lines with other central banks (6 April 2009 – 1 February 2010; and 30 November 2011 – 31 December 2012); $R_{i,j,t-k}$ - lagged (k = 1, 2 and 3) values of dependent variable; the $Other_t$ captures (macroeconomic) control variables and include VIX – to control for investor sentiment and market volatility; *EMBIG spread* - to control for global perceptions of risks to emerging market countries; Exchange rate (CHF/EUR) return – to control for movements on FX markets; European banking systems performance (STOXX® Europe 600 Banks index return) – to control for European banking system overall performance. We include country fixed effects ν_j and time (quarter) fixed effects μ_q in all specifications to control for omitted variables. Standard errors are reported in brackets and account for clustering at the country level. We use ***, **, and * to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent: bank performance	Model 1	Model 2	Model 3	Model 4
SNB-CEE	0.2573***	0.2577***	0.2415***	0.2472***
	(0.0439)	(0.0441)	(0.0360)	(0.0362)
SNB-ECB	0.0647	0.0649		
	(0.0423)	(0.0399)		
SNB-USD	0.1142		0.0688	
	(0.1170)		(0.1106)	
SNB-CBs	−0.1135***			−0.0559
	(0.0301)			(0.0518)
Bank performance (Lag 1)	−7.3337**	−7.3214**	−7.3223**	−7.3225**
	(3.0990)	(3.0950)	(3.0991)	(3.0915)
Bank performance (Lag 2)	−3.1036***	−3.0990***	−3.0991***	−3.0967***
	(0.8584)	(0.8556)	(0.8567)	(0.8541)
Bank performance (Lag 3)	−1.4410*	−1.4390*	−1.4381*	−1.4371*
	(0.8383)	(0.8362)	(0.8376)	(0.8353)
VIX	−0.0298***	−0.0282***	−0.0289***	−0.0285***
	(0.0058)	(0.0054)	(0.0057)	(0.0054)
EMBIG spread	−0.0038	−0.0036	−0.0037	−0.0036
	(0.0023)	(0.0024)	(0.0024)	(0.0025)
Exchange rate (CHF/EUR) return	19.0917***	19.0269***	19.0704***	19.0391***
	(3.3173)	(3.3402)	(3.3120)	(3.3360)
European banking systems performance	16.7883***	16.8588***	16.8367***	16.8384***
	(5.9189)	(5.8952)	(5.9189)	(5.8835)
Constant	1.0872**	1.0365**	1.0710**	1.0490**
	(0.4309)	(0.4562)	(0.4316)	(0.4598)
Country FE	YES	YES	YES	YES
Time (Quarter) FE	YES	YES	YES	YES
Time*Country FE	YES	YES	YES	YES
R-squared	0.4808	0.4803	0.4803	0.4802
N. of cases	71,888	71,888	71,888	71,888
Mean of dependent variable	−0.0421	−0.0421	−0.0421	−0.0421

$SWAP_{jt}^{SNB|CEE}$, $SWAP_{jt}^{SNB|NBP}$ and $SWAP_{jt}^{SNB|MNB}$ remain significant and economically large even in the presence of announcement effects. The regressions show that Hungarian and Polish banks benefitted from swap line access with the SNB over the full period and this swap line effect cannot be attributed to a one-time announcement effect. Although the empirical results suggest that Hungarian banks responded more strongly to swap lines than Polish banks, this result needs to be interpreted with caution. The number of Hungarian banks (2 banks) in our sample is considerably smaller than the number of Polish banks (10 banks). Because of this difference in the number of banks, it is our preference to work with $SWAP_{jt}^{SNB|CEE}$ rather than the individual country dummies for the SNB-MNB and SNB-NBP swap lines.

Next, we test the robustness of $SWAP_{jt}^{SNB|CEE}$ against other SNB swap lines with major central banks. Table 7 shows regressions with $SWAP_{jt}^{SNB|CEE}$ along with $SWAP_{jt}^{SNB|ECB}$ in EUR/CHF, $SWAP_{jt}^{SNB|MULT1}$ in USD/CHF, and $SWAP_{jt}^{SNB|MULT2}$ in various currencies. The regressions show that $SWAP_{jt}^{SNB|CEE}$ remains positive and significant, whereas the coefficients of the two multilateral swap lines are much smaller and in two cases negative. Further, the statistical significance is not established for the multilateral swap lines. We interpret these country-level results as follows: there was no spillover effect of multilateral swap lines between major central banks to the CEE. Banks in CEE benefited only from having direct access to liquidity via the SNB swap lines.

In the next subsection, the specification in column 1 in Table 3 without $Date_{jt}^{SNB|CEE}$ is treated as the baseline. The exclusion of the time dummy, $Date_{jt}^{SNB|CEE}$, is motivated by the non-robust results in Table 4 in the shorter sample (the result suggests that potential spillovers from swap lines outside national jurisdictions were only temporary and we are interested in the liquidity effect during the whole duration for banks with different characteristics). To test the four propositions outlined in Section 5.2, bank specific information together with its interaction with the swap dummy is added to the baseline specification.

5.2. Bank-level responses to SNB swap lines

This subsection presents evidence on the stock price response of Hungarian and Polish banks controlling for bank specific characteristics. The findings show that bank characteristics are important for understanding the stock price response to swap lines. The bank characteristics are motivated by the four propositions discussed in

Table 8
Controlling for the level of foreign currency exposure (FX). This table reports the results of regressions that examine the impact of the SNB swap on Hungarian and Polish banks controlling for the level of foreign currency exposure. We estimate alternative versions of the following regression specification:
$R_{i,j,t} = \beta_1 \times SWAP_{jt}^{SNB|CEE} + \beta_1 \times FX_{i,j,t} + \beta_1 \times SWAP_{jt}^{SNB|CEE} * FX_{i,j,t} + \Sigma_{1=k}^{K} \alpha_k R_{i,j,t-k} + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}$
where $R_{i,j,t}$ denotes the bank performance measured as the change in the ln share price of a CEE bank i in country j at time t; the dummy variable, SNB-CEE ($SWAP_{jt}^{SNB|CEE}$) – is a dummy variable taking a one if the bank operates in Hungary for period 2 February 2009–25 January 2010 or in Poland for period 17 November 2008–25 January 2010; *FX* denotes one of the alternative measure for the level of foreign currency exposure: *Share of assets in CHF* = (Assets in CHF/ Total assets); *Share of assets in foreign currencies* = (Total assets in foreign currencies/ Total assets); *Net position in CHF* = [(Assets in CHF – Liabilities in CHF)/Total assets]; *Net position in foreign currencies* = [(Total assets in foreign currencies – Total liabilities in foreign currencies)/Total assets]; *Share of liabilities in CHF* = (Liabilities in CHF/ Total assets); *Share of liabilities in foreign currencies* = (Total liabilities in foreign currencies/ Total assets); $SWAP_{jt}^{SNB|CEE} * FX_{i,j,t}$ denotes the interaction between SNB-CEE *swap variable* and *FX variables;* $R_{i,j,t-k}$ - lagged (k = 1, 2 and 3) values of dependent variable; the $Other_t$ captures (macroeconomic) control variables and include *VIX* – to control for investor sentiment and market volatility; *EMBIG spread* - to control for global perceptions of risks to emerging market countries; *Exchange rate (CHF/EUR) return* – to control for movements on FX markets; *European banking systems performance* (STOXX® Europe 600 Banks index return) – to control for European banking system overall performance. We include country fixed effects ν_j and time (quarter) fixed effects μ_q in all specifications to control for omitted variables. Standard errors are reported in brackets and account for clustering at the country level. We use ***, **, and * to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent: bank performance	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
SNB-CEE	0.2944***	0.1784***	0.3032***	0.2471***	0.2849***	0.1889***
	(0.0261)	(0.0267)	(0.0317)	(0.0380)	(0.0280)	(0.0279)
Share of assets in CHF	−0.1153*					
	(0.0690)					
SNB-CEE * Share of assets in CHF	0.1054*					
	(0.0541)					
Share of assets in foreign currencies		−0.0324*				
		(0.0177)				
SNB-CEE * Share of assets in foreign currencies		0.1629***				
		(0.0226)				
Net position in CHF			−0.0316			
			(0.1014)			
SNB-CEE * Net position in CHF			−0.0985			
			(0.1006)			
Net position in foreign currencies				0.0622		
				(0.0689)		
SNB-CEE * Net position in foreign currencies				−0.0800		
				(0.0590)		
Share of liabilities in CHF					−0.0027	
					(0.1071)	
SNB-CEE * Share of liabilities in CHF					0.1699*	
					(0.1029)	
Share of liabilities in foreign currencies						−0.0384**
						(0.0184)
SNB-CEE * Share of liabilities in foreign currencies						0.1549***
						(0.0230)
Bank performance (Lag 1)	−3.8281	−7.6248**	−3.8285	−7.6226**	−3.8275	−7.6254**
	(2.6206)	(3.1854)	(2.6204)	(3.1868)	(2.6221)	(3.1855)
Bank performance (Lag 2)	−2.9148***	−3.0875***	−2.9154***	−3.0843***	−2.9143***	−3.0886***
	(0.6776)	(0.8983)	(0.6785)	(0.8987)	(0.6790)	(0.8980)
Bank performance (Lag 3)	−1.0933*	−1.4413*	−1.0940*	−1.4385*	−1.0929*	−1.4426*
	(0.6029)	(0.8248)	(0.6038)	(0.8238)	(0.6035)	(0.8244)
VIX	−0.0295***	−0.0279***	−0.0295***	−0.0279***	−0.0295***	−0.0279***
	(0.0052)	(0.0055)	(0.0052)	(0.0054)	(0.0052)	(0.0055)
EMBIG spread	−0.0046	−0.0038	−0.0046	−0.0038	−0.0046	−0.0038
	(0.0039)	(0.0025)	(0.0039)	(0.0025)	(0.0039)	(0.0025)
Exchange rate (CHF/EUR) return	23.3630***	18.7787***	23.3634***	18.7805***	23.3638***	18.7791***
	(2.8523)	(3.4392)	(2.8529)	(3.4389)	(2.8522)	(3.4393)
European banking systems performance	25.6445***	16.8913***	25.6443***	16.8909***	25.6444***	16.8912***
	(6.5875)	(6.0382)	(6.5874)	(6.0383)	(6.5876)	(6.0381)
Constant	1.2454*	1.1134**	1.2466*	1.0982**	1.2450*	1.1116**
	(0.7118)	(0.4625)	(0.7100)	(0.4607)	(0.7086)	(0.4613)
Country FE	YES	YES	YES	YES	YES	YES
Time (Quarter) FE	YES	YES	YES	YES	YES	YES
R-squared	0.8119	0.4804	0.8119	0.4800	0.8119	0.4805
N. of cases	32,756	69,425	32,756	69,425	32,756	69,425
Mean of dependent variable	−0.0421	−0.0421	−0.0421	−0.0421	−0.0421	−0.0421

Section 3. They include information on the bank's foreign currency exposure, funding structure, ownership type, and capital structure. The empirical findings show that the response of bank stocks to swap lines is dependent on bank characteristics.

Table 8 presents regressions that test proposition 1′s conjecture: higher currency exposure should result in a higher stock price response. The results for exposure measured as share of FX or CHF assets or liabilities show that stock prices of CEE banks with a high foreign currency exposure recorded a lower return than banks with less FX assets or liabilities. Next, the interaction terms between foreign currency exposure and $SWAP_{jt}^{SNB|CEE}$ are considered. There is strong evidence that stock prices of Hungarian and Polish banks with a high foreign currency exposure in their asset and/or liabilities position responded positively to swap lines. Our results show that banks with a larger exposure on CHF assets or liabilities (Model 1 and Model 5) and banks with a larger exposure on

Table 9
Controlling for funding structure. This table reports the results of regressions that examine the impact of the SNB swap on Hungarian and Polish banks controlling for funding structure. We estimate alternative versions of the following regression specification:
$R_{i,j,t} = \beta_1 \times SWAP_{jt}^{SNB|CEE} + \beta_1 \times Fund\_struct_{i,j,t} + \beta_1 \times SWAP_{jt}^{SNB|CEE} * Fund\_struct_{i,j,t} + \Sigma_{1=k}^{K} \alpha_k R_{i,j,t-k} + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}$
where $R_{i,j,t}$ denotes the bank performance measured as the change in the ln share price of a CEE bank i in country j at time t; the dummy variable, SNB-CEE ($SWAP_{jt}^{SNB|CEE}$) – is a dummy variable taking a one if the bank operates in Hungary for period 2 February 2009–25 January 2010 or in Poland for period 17 November 2008–25 January 2010; *Fund_struct* measured using Funding fragility - the ratio between the sum of deposits from other banks, other deposits, and short term borrowing over total deposits plus money market and short-term funding; $SWAP_{jt}^{SNB|CEE} * Fund\_struct_{i,c,t}$ denotes the interaction between SNB-CEE *swap variable* and *Funding structure variables;* $R_{i,j,t-k}$ - lagged (k = 1, 2 and 3) values of dependent variable; the $Other_t$ captures (macroeconomic) control variables and include *VIX* – to control for investor sentiment and market volatility; *EMBIG spread* - to control for global perceptions of risks to emerging market countries; *Exchange rate (CHF/EUR) return* – to control for movements on FX markets; *European banking systems performance* (STOXX® Europe 600 Banks index return) – to control for European banking system overall performance. We include country fixed effects ν_j and time (quarter) fixed effects μ_q in all specifications to control for omitted variables. Standard errors are reported in brackets and account for clustering at the country level. We use ***, **, and * to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent: bank performance	Model 1
SNB-CEE	0.1325***
	(0.0321)
Funding fragility	−0.1569***
	(0.0538)
SNB-CEE * Funding fragility	0.2874***
	(0.0922)
Bank performance (Lag 1)	−7.3365**
	(3.1033)
Bank performance (Lag 2)	−3.0853***
	(0.8686)
Bank performance (Lag 3)	−1.4819*
	(0.8222)
VIX	−0.0282***
	(0.0054)
EMBIG spread	−0.0036
	(0.0025)
Exchange rate (CHF/EUR) return	19.0191***
	(3.3437)
European banking systems performance	16.8905***
	(5.9007)
Constant	1.1044**
	(0.4576)
Country FE	YES
Time (Quarter) FE	YES
R-squared	0.4835
N. of cases	71,398
Mean of dependent variable	−0.0421

FX assets or liabilities (Model 2 and Model 6) benefited more than banks with lower or no exposure on FX assets or liabilities. Results from Models 3 and 4 reveal that the net position in CHF or foreign currencies does not impact the stock return.

Table 9 presents information on the stock price response to information on a bank's funding structure. Funding structure is proxied by funding fragility. Proposition 2 says that the stock price of banks relying on short-term funding will respond positively to a swap line agreement. Funding fragility has a coefficient of -0.1569 that is highly significant. This says that if a bank's funding structure is short term, the bank's stock price falls. However, the coefficient's sign reverses for Hungarian and Polish banks when they have access to swap lines. The interaction of swap lines and funding fragility has a coefficient of 0.2874 and is statistically significant. From this evidence, we conclude that the funding structure is an important factor in explaining the stock price response to swap lines.

Table 10 presents regressions that test the importance of ownership structure. The evidence is consistent with Proposition 3. The proposition says that foreign-owned banks have access to foreign exchange through the parent bank, however domestic banks do not enjoy this form of liquidity insurance when interbank markets are impaired. The prior is the stock price of local banks should respond positively to swap lines. To test this, column 1 in Table 10 presents a regression which introduces a foreign ownership dummy (+1 when more than 50% of the bank's assets is foreign owned) and the interaction term to the baseline specification. The coefficient of the foreign ownership dummy is 0.0324. This says that the return on stock prices of foreign owned CEE banks was on average higher than local CEE banks. Next, the coefficient of the foreign ownership dummy interacted with the swap dummy is -0.1040 and is statistically significant at the 10% level. This result says that stock prices of local banks in Hungary and Poland increased more than the average Hungarian and Polish bank during the period of the swap line.

An alternative measure of international connectedness, defined as member of a banking group, is considered in column 2 of Table 10. The dummy, banking group, is + 1 when a bank is part of a banking group with subsidiaries in at least five countries in the CEE region. Note, this form of organizational structure does imply foreign ownership and therefore possible access to foreign exchange through the parent bank. The results for bank group show that the coefficient of the dummy is 0.0302 and statistically significant. However, the coefficient of the interaction term is 0.0225 and statistically significant at the 10% level. This result highlights the importance of ownership as opposed to connectedness, because the stock price of banks active in international banking groups benefitted from liquidity access through swap lines.

Table 11 presents evidence consistent with Proposition 4 that says swap lines supported CEE banks with a weak capital structure. In other words, the stock price of banks with a less sound capital structure responded strongly to swap lines. To see this, column 1 in Table 11 presents a regression that adds the total capital ratio of banks (CAP1) and their interaction term ($SWAP_{jt}^{SNB|CEE} * CAP1$) to

Table 10
Controlling for degree of international connectedness. This table reports the results of regressions that examine the impact of the SNB swap on Hungarian and Polish banks controlling for degree of international connectedness. We estimate alternative versions of the following regression specification:
$R_{i,j,t} = \beta_1 \times SWAP_{jt}^{SNB|CEE} + \beta_1 \times Connect_{i,j,t} + \beta_1 \times SWAP_{jt}^{SNB|CEE} * Connect_{i,j,t} + \Sigma_{1=k}^{K} \alpha_k R_{i,j,t-k} + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}$
where $R_{i,j,t}$ denotes the bank performance measured as the change in the ln share price of a CEE bank i in country j at time t; the dummy variable SNB-CEE ($SWAP_{jt}^{SNB|CEE}$) – is a dummy variable taking a one if the bank operates in Hungary for period 2 February 2009–25 January 2010 or in Poland for period 17 November 2008–25 January 2010; *Connect* denotes one of the alternative measure for degree of international connectedness: *Foreign ownership* is a dummy variable taking a one if 50% or more of banks' shares are owned by foreigners; *Member of Banking group* is a dummy variable taking a one if the bank is a subsidiary of a International banking group with at least 5 subsidiaries in CEE region; $SWAP_{jt}^{SNB|CEE} * Connect_{i,j,t}$ denotes the interaction between SNB-CEE *swap variable* and *Degree of international connectedness variables;* $R_{i,j,t-k}$ - lagged (k = 1, 2 and 3) values of dependent variable; the $Other_t$ captures (macroeconomic) control variables and include *VIX* – to control for investor sentiment and market volatility; *EMBIG spread* - to control for global perceptions of risks to emerging market countries; *Exchange rate (CHF/EUR) return* – to control for movements on FX markets; *European banking systems performance* (STOXX® Europe 600 Banks index return) – to control for European banking system overall performance. We include country fixed effects ν_j and time (quarter) fixed effects μ_q in all specifications to control for omitted variables. Standard errors are reported in brackets and account for clustering at the country level. We use ***, **, and * to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent: bank performance	Model 1	Model 2
SNB-CEE	0.3184***	0.2418***
	(0.0733)	(0.0342)
Foreign ownership	0.0324*	
	(0.0208)	
SNB-CEE * Foreign ownership	−0.1040*	
	(0.0428)	
Member of Banking group		0.0302*
		(0.0178)
SNB-CEE * Member of Banking group		0.0225*
		(0.0112)
Bank performance (Lag 1)	−7.3242**	−7.3202**
	(3.0973)	(3.0954)
Bank performance (Lag 2)	−3.1020***	−3.0978***
	(0.8567)	(0.8551)
Bank performance (Lag 3)	−1.4417*	−1.4380*
	(0.8383)	(0.8365)
VIX	−0.0283***	−0.0282***
	(0.0054)	(0.0054)
EMBIG spread	−0.0036	−0.0036
	(0.0025)	(0.0025)
Exchange rate (CHF/EUR) return	19.0379***	19.0362***
	(3.3356)	(3.3347)
European banking systems performance	16.8562***	16.8567***
	(5.8957)	(5.8959)
Constant	1.0201**	1.0404**
	(0.4599)	(0.4592)
Country FE	YES	YES
Time (Quarter) FE	YES	YES
R-squared	0.4806	0.4802
N. of cases	71,888	71,888
Mean of dependent variable	−0.0421	−0.0421

the baseline regression. The coefficient for CAP1 is close to zero and statistically insignificant, yet the coefficient of the interaction term is -0.0242 and is statistically significant. This result says that the stock price of Hungarian and Polish banks with a higher capital ratio did not increase as much as those with a low capital ratio. Next, the regression with Tier 1 capital (CAP2) is presented in column 2. Again, the coefficient of the capital structure term, CAP2, is close to zero and statistically insignificant. However, the interaction term, $SWAP_{jt}^{SNB|CEE} * CAP2$, is -0.0147 and statistically significant. From this evidence, we conclude that the stock price of less-well capitalized banks in Hungary and Poland responded more strongly to the timing of a swap line agreement than did the stock price of banks with a more sound capital structure. This result suggests, whether intended or not, swap lines also had a financial stability dimension.

6. Conclusions

The strong response of CEE bank stocks to swap lines suggests that this unconventional form of liquidity provision impacted a broader range of financial assets (i.e., interest rate spreads, CDS rates, or exchange rates) than has been previously examined. The analysis for bank stocks reconfirms findings in previous studies that gains from swap lines outside national jurisdictions were limited and/or temporary. This empirical finding re-enforces the desire of emerging market economies to sign international swap lines with central banks of major currencies.

The analysis of bank stocks also allow us to go one level deeper and to determine whether swap lines triggered asymmetric response effects at the bank level. The literature has until now assumed that financial assets respond uniformly to swap lines. The bank-level analysis suggests that the effectiveness of international swap lines is also partially dependent on the structure of a country's banking system. Stock prices of local and less-well capitalized banks, as well as banks with a higher foreign currency exposure and higher reliance of short-term fund responded the strongest to swap line agreements. This new evidence is consistent with the view that swap lines were not only important in providing liquidity but also took on functions associated with micro-prudential concerns.

Table 11
Controlling for capital structure. This table reports the results of regressions that examine the impact of the SNB swap on Hungarian and Polish banks controlling for capital structure. We estimate alternative versions of the following regression specification:
$R_{i,j,t} = \beta_1 \times SWAP_{jt}^{SNB|CEE} + \beta_1 \times Cap\_struct_{i,j,t} + \beta_1 \times SWAP_{jt}^{SNB|CEE} * Cap\_struct_{i,j,t} + \Sigma_{1=k}^{K} \alpha_k R_{i,j,t-k} + Other_t + \nu_j + \mu_q + \varepsilon_{i,j,t}$
where $R_{i,\,j,\,t}$ denotes the bank performance measured as the change in the ln share price of a CEE bank i in country j at time t; the dummy variable SNB-CEE ($SWAP_{jt}^{SNB|CEE}$) – is a dummy variable taking a one if the bank operates in Hungary for period 2 February 2009–25 January 2010 or in Poland for period 17 November 2008–25 January 2010; *Cap_struct* denotes one of the alternative capital structure measure: *Cap_struct1* = Total capital Ratio; *Cap_struct2* = Tier 1 Ratio; $SWAP_{jt}^{SNB|CEE} * Cap\_struct_{i,j,t}$ denotes the interaction between SNB-CEE *swap variable* and *Capital structure variables;* $R_{i,j,t-k}$ - lagged (k = 1, 2 and 3) values of dependent variable; the $Other_t$ captures (macroeconomic) control variables and include *VIX* – to control for investor sentiment and market volatility; *EMBIG spread* - to control for global perceptions of risks to emerging market countries; *Exchange rate (CHF/EUR) return* – to control for movements on FX markets; *European banking systems performance* (STOXX® Europe 600 Banks index return) – to control for European banking system overall performance. We include country fixed effects ν_j and time (quarter) fixed effects μ_q in all specifications to control for omitted variables. Standard errors are reported in brackets and account for clustering at the country level. We use ***, **, and * to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent: bank performance	Model 1	Model 2
SNB-CEE	0.5668***	0.4274***
	(0.1367)	(0.0736)
Cap_struct1	0.0015	
	(0.0025)	
SNB-CEE * Cap_struct1	−0.0242**	
	(0.0119)	
Cap_struct2		0.0021
		(0.0019)
SNB-CEE * Cap_struct2		−0.0147**
		(0.0058)
Bank performance (Lag 1)	−7.2679**	−2.9755
	(3.1928)	(3.4289)
Bank performance (Lag 2)	−3.1225***	−2.7330***
	(0.9550)	(0.8246)
Bank performance (Lag 3)	−1.4896*	−0.3493
	(0.8578)	(0.7452)
VIX	−0.0288***	−0.0308***
	(0.0057)	(0.0053)
EMBIG spread	−0.0034	−0.0040
	(0.0027)	(0.0031)
Exchange rate (CHF/EUR) return	18.9050***	19.8092***
	(3.0656)	(3.3163)
European banking systems performance	18.0061***	22.0537***
	(5.8355)	(6.4286)
Constant	0.9915*	1.1145**
	(0.5167)	(0.5523)
Country FE	YES	YES
Time (Quarter) FE	YES	YES
R-squared	0.5158	0.7371
N. of cases	65,453	46,039
Mean of dependent variable	−0.0421	−0.0421

Appendix A. List of banks.

Bank name	Bank code (BankScope)	Host country	Total assets (2008 – Mil. EUR)	Ownership
Hypo Alpe-Adria-Bank a.d. Banja Luka	29,065	Bosnia and Herzegovina	979	Foreign
Intesa Sanpaolo Banka d.d. Bosna i Hercegovina	46,742	Bosnia and Herzegovina	517	Foreign
NLB Banka d.d.	45,854	Bosnia and Herzegovina	406	Foreign
Sparkasse Bank dd	40,547	Bosnia and Herzegovina	269	Foreign
UniCredit Bank dd	46,705	Bosnia and Herzegovina	1688	Foreign
Corporate Commercial Bank AD	15,330	Bulgaria	1091	Domestic
First Investment Bank AD	43,151	Bulgaria	2212	Domestic
Erste & Steiermarkische Bank dd	31,492	Croatia	6394	Foreign
Hrvatska Postanska Bank DD	27,044	Croatia	2040	Domestic
Jadranska Banka dd	47,953	Croatia	328	Domestic
Podravska Banka	47,433	Croatia	388	Domestic
Privredna Banka Zagreb d.d	31,139	Croatia	9927	Foreign
Zagrebacka Banka dd	33,081	Croatia	14,501	Foreign
Komercni Banka	42,320	Czech Republic	25,965	Foreign
FHB Mortgage Bank Plc	18,740	Hungary	2637	Domestic
OTP Bank Plc	44,850	Hungary	35,821	Domestic
AS DNB Banka	33,110	Latvia	3179	Foreign
AB DNB Bankas	38,058	Lithuania	4092	Foreign
Siauliu Bankas	38,681	Lithuania	610	Domestic
Komercijalna Banka A.D. Skopje	35,919	Macedonia (FYROM)	909	Domestic
Stopanska Banka a.d. Skopje	30,961	Macedonia (FYROM)	981	Foreign
Stopanska Banka AD, Bitola	45,348	Macedonia (FYROM)	112	Domestic
TTK Banka AD Skopje	25,280	Macedonia (FYROM)	102	Domestic
Hipotekarna Banka ad Podgorica	28,971	Montenegro	75	Domestic
Bank BPH SA	31,077	Poland	8898	Foreign
Bank Handlowy w Warszawie S.A.	30,746	Poland	10,323	Foreign
Bank Millennium	45,307	Poland	11,428	Foreign
Bank Polska Kasa Opieki SA	31,008	Poland	32,010	Foreign
Bank Zachodni WBK S.A.	32,473	Poland	13,934	Foreign
BNP Paribas Bank Polska SA	11,560	Poland	4825	Foreign
ING Bank Slaski S.A. - Capital Group	48,129	Poland	16,888	Foreign
Kredyt Bank SA	48,171	Poland	9396	Foreign
Nordea Bank Polska SA	48,321	Poland	3820	Foreign
Powszechna Kasa Oszczednosci Bank Polski SA	33,088	Poland	32,663	Domestic
BRD-Groupe Societe Generale SA	36,742	Romania	12,910	Foreign
Banca Transilvania SA	44,741	Romania	4348	Domestic
AIK Banka ad Nis	16,829	Serbia	953	Domestic
Komercijalna Banka A.D. Beograd	12,565	Serbia	1952	Domestic
Vseobecna Uverova Banka a.s.	35,884	Slovakia	11,232	Foreign
OTP Banka Slovensko, as	38,552	Slovakia	1621	Foreign
Prima banka Slovensko a.s.	44,132	Slovakia	2715	Foreign
Sberbank Slovensko, as	42,553	Slovakia	1530	Foreign
Tatra Banka a.s.	37,500	Slovakia	10,551	Foreign
Abanka Vipa dd	35,837	Slovenia	3883	Domestic
Nova Kreditna Banka Maribor d.d.	31,186	Slovenia	5490	Domestic
Ukrsotsbank	46,068	Ukraine	4607	Foreign
Raiffeisen Bank Aval	46,840	Ukraine	6314	Foreign

Appendix B. Definition of all variables.

Variable	Definition	Source
Bank performance	Daily stock return calculated as $R_{i,j,t} = \ln(P_{i,j,t} - P_{i,j,t-1})$, where $P_{i,j,t}$ denotes the daily stock price for bank *i* in country *j* for day *t*.	Thomson Reuters
SNB-CEE	Dummy variable is +1 if the bank operates in Hungary for the period from 28 January 2009 to 25 January 2010 or in Poland for the period from 7 November 2008 to 25 January 2010; otherwise 0.	SNB press releases
SNB-ECB	Dummy variable is + 1 if the bank operates in any member country of the Euro zone for the period from 16 October 2008 to25 January 2010; otherwise 0.	SNB press releases
SNB-MNB	Dummy variable is + 1 if the bank operates in Hungary for the period from 28 January 2009 to 25 January 2010; otherwise 0.	SNB press releases
SNB-NBP	Dummy variable is + 1; if the bank operates in Poland for the period from 7 November 2008 to 25 January 2010; otherwise.	SNB press releases
SNB-USD	Dummy variable is + 1 if SNB has Dollar Liquidity Swap Lines with the FED or other banks for the periods from 12 December 2007 to 1 February 2010 and from May 2010 to 31 December 2012); otherwise 0.	SNB press releases
SNB-CBs	Dummy variable is + 1 if SNB has CHF Liquidity Swap Lines with other central banks for the periods from6 April 2009 to 1 February 2010 and from 30 November 2011 to 31 December 2012; otherwise 0.	SNB press releases
Date	Dummy variable is + 1 for the period when the swap lines with country or group X are active and 0 otherwise 0.	SNB press releases
Country	Dummy variable is + 1 for the country or group X which had a swap lines with SNB; otherwise 0.	SNB press releases
SNB-Signal	Dummy variable is a preliminary announcement dummy and is + 1 for the previous 5 working days to the period and country when the swap lines with country or group X are active; otherwise 0.	SNB press releases
Share of assets in CHF	Assets in CHF/ Total assets.	Annual reports
Share of assets in foreign currencies	Total assets in foreign currencies/ Total assets.	Annual reports
Net position in CHF	(Assets in CHF – Liabilities in CHF)/Total assets.	Annual reports
Net position in foreign currencies	(Total assets in foreign currencies – Total liabilities in foreign currencies)/Total assets.	Annual reports
Share of liabilities in CHF	Liabilities in CHF/ Total liabilities.	Annual reports
Share of liabilities in foreign currencies	Total liabilities in foreign currencies/ Total liabilities.	Annual reports
Customer deposits	Total Customer Deposits / Loans.	Bureau van Dijk – BankScope
Funding fragility	The ratio between the sum of deposits from other banks, other deposits, and short term borrowing over total deposits plus money market and short-term funding.	Bureau van Dijk – BankScope
Foreign ownership	Dummy variable is + 1 if 50% or more of banks' shares are owned by foreigners; otherwise 0.	Bureau van Dijk – BankScope
Member of Banking group	Dummy variable + 1 if the bank is a subsidiary of a International banking group with at least 5 subsidiaries in the CEE region; otherwise 0.	Annual reports
Cap_struct1	Total capital Ratio	Bureau van Dijk – BankScope
Cap_struct2	Tier 1 Ratio	Bureau van Dijk – BankScope
VIX	VIX measures market expectation of near term volatility conveyed by stock index option prices.	Federal reserve economic data
EMBIG spread	EMBIG spread - JPMorgan Emerging Markets Bond Index spread against Eurozone Sovereign Bond Index.	Thomson Reuters
Exchange rate (CHF/EUR) return	Swiss franc/EUR exchange rate return.	Thomson Reuters
European banking systems performance	Measured using STOXX® Europe 600 Banks index return.	Thomson Reuters

Appendix C. Correlation matrix.

	Bank performance	SNB-CEE	SNB-ECB	SNB-USD	SNB-CBs	VIX	Exchange rate (CHF/EUR) return	European banking systems performance	EMBIG spread	Share of assets in CHF	Share of assets in foreign currencies	Net position in CHF	Net position in foreign currencies	Share of liabilities in CHF	Share of liabilities in foreign currencies	Funding fragility	Foreign ownership	Member of Banking group	Cap_struct1	Cap_struct2
Bank performance	1.0000																			
SNB-CEE	0.0346	1.0000																		
SNB-ECB	−0.0004	−0.0616	1.0000																	
SNB-USD	−0.0283	0.1703	0.0798	1.0000																
SNB-CBs	0.0382	0.3915	0.1612	0.2634	1.0000															
VIX	−0.0921	0.3071	0.1744	0.3853	−0.0218	1.0000														
Exchange rate (CHF/EUR) return	0.1120	0.0047	0.0039	−0.0273	−0.0007	−0.0247	1.0000													
European banking systems performance	0.3229	0.0253	0.0084	−0.0183	0.0511	−0.1246	0.2415	1.0000												
EMBIG spread	0.0011	−0.1878	−0.1007	0.3900	0.3768	−0.2069	−0.0257	0.0185	1.0000											
Share of assets in CHF	0.0044	0.1677	−0.1095	0.0868	−0.0274	0.0484	−0.0078	−0.0064	0.0036	1.0000										
Share of assets in foreign currencies	0.0094	0.0914	−0.2124	0.0019	0.0113	0.0185	−0.0042	0.0028	−0.0490	0.5240	1.0000									
Net position in CHF	−0.0004	0.0823	−0.0936	0.0665	−0.0355	0.0048	−0.0064	−0.0056	0.0379	0.8518	0.3380	1.0000								
Net position in foreign currencies	0.0059	0.0503	−0.0647	−0.1450	−0.0905	−0.1077	0.0058	−0.0025	−0.0492	0.5781	0.2328	0.7119	1.0000							
Share of liabilities in CHF	0.0090	0.1795	−0.0495	0.0525	0.0080	0.0840	−0.0040	−0.0027	−0.0574	0.4586	0.4241	−0.0749	−0.1070	1.0000						
Share of liabilities in foreign currencies	0.0058	0.0608	−0.1703	0.0824	0.0612	0.0778	−0.0073	0.0041	−0.0203	0.1878	0.8416	−0.0671	−0.3292	0.4713	1.0000					
Funding fragility	−0.0005	0.0039	0.1027	0.0312	0.0119	0.0303	−0.0041	−0.0001	−0.0633	0.2649	0.5903	0.0602	−0.0923	0.4021	0.6244	1.0000				
Foreign ownership	0.0131	0.0536	−0.2190	−0.1470	−0.0645	−0.0929	0.0117	0.0000	−0.1036	0.0468	−0.0799	0.0296	0.2520	0.0389	−0.2175	−0.3248	1.0000			
Member of Banking group	−0.0048	−0.0137	−0.1223	0.0400	0.0618	−0.0044	−0.0020	0.0018	0.0742	−0.0349	0.2606	−0.0890	−0.0386	0.0846	0.2744	−0.0277	0.2140	1.0000		
Cap_struct1	0.0118	−0.1157	−0.1019	−0.0007	0.0888	−0.0454	−0.0012	0.0082	0.1234	−0.2804	0.0927	−0.1796	−0.1598	−0.2291	0.1787	0.0774	−0.1019	0.1022	1.0000	
Cap_struct2	0.0130	−0.0986	−0.1310	−0.0224	0.0496	−0.0271	−0.0015	0.0071	0.0724	−0.2960	0.1167	−0.2091	−0.2832	−0.2087	0.2706	0.1028	−0.1264	−0.0216	0.9205	1.0000

References

Adrian, T., Shin, H.S., 2010. Liquidity and leverage. J Financ. Intermed. 19, 418–437.
Aizenman, J., Pasricha, G.K., 2010. Selective swap arrangements and the global financial crisis: analysis and interpretation. Int. Rev. Econ. Finance 19, 353–365.
Alfaro, L., Chari, A., Kanczuk, F., 2014. The Real Effects of Capital Controls: Credit Constraints, Exporters and Firm Investment. Harvard Business School Working Paper 15-016.
Altunbas, Y., Manganelli, S., Marqus-Ibanez, D., 2011. Bank Risk during the Financial Crisis: Do Business Models Matter?. European Central Bank Working Paper, No. 1394.
Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. The Review of Economic Studies 58, 277–297.
Auer, R.A., Kraenzlin, S., 2011. International liquidity provision during the financial crisis: a view from Switzerland. Fed. Res. Bank St. Louis Rev. 93 (6), 409–418.
Baba, N., Shim, I., 2010. Policy responses to dislocations in the FX swap market: the experience of Korea. BIS Quart. Rev. (June) 29–39.
Basso, H., Calvo-Gonzalez, O., Jurgilas, M., 2011. Financial dollarization: the role of foreign-owned banks and interest rates. J. Banking Finance 35 (4), 794–806.
Bauer, M.D., Neely, M., 2014. International channels of the Feds unconventional monetary policy. J. Int. Money Finance 44, 24–46.
Beer, C., Ongena, S., Peter, M., 2010. Borrowing in foreign currency: Austrian households as carry traders. J. Banking Finance 34 (9), 2198–2211.
Beck, N., Katz, J.N., 1995. What to do (and what not to do) with time-series cross–section data. Am. Pol. Sci. Rev. 89 (3), 634–647.
Beltratti, A., Stulz, R.M., 2012. The credit crisis around the globe: why did some banks perform better. J. Financ. Econ. 105, 1–17.
Berger, A., Bouwman, C., 2013. How does capital affect bank performance during financial crises? J. Financ. Econ. 109 (1), 146–176.
Bertrand, M., Duflo, E., Mullainathan, S., 2004. How much should we trust differences-in-differences estimates? Quart. J. Econ. 119 (1), 249–275.
Brown, M., De Haas, R., 2012. Foreign banks and foreign currency lending in emerging Europe. Econ. Policy 27 (69), 57–98.
Brown, M., Ongena, S., Yesin, P., 2014. Information asymmetry and foreign currency borrowing by small firms. Comp. Econ. Stud. 56 (1), 110–131.
Brown, M., Ongena, S., Yesin, P., 2011. Foreign currency borrowing by small firms in the transition economies. J. Financ. Intermed. 20 (3), 285–302.
Bruno, V., Shin, H.S., 2014. Assessing macroprudential policies: case of south Korea. Scand. J. Econ. 116 (1), 128–157.
Chodorow-Reich, G., 2014. In: Effects of Unconventional Monetary Policy on Financial Institutions, 48. The Brookings Institution, pp. 155–227. Brookings Papers on Economic Activity, Economic Studies Program.
Claessens, S., van Horen, N., 2014. Foreign banks: trends and impact. J. Money, Credit Banking 46 (1), 295–326.
Demirgüç-Kunt, A., Huizinga, H., 2010. Bank activity and funding strategies: the impact on risk and return. J. Financ. Econ. 98, 626–650.
Demirgüç-Kunt, A., Detragiache, E., Merrouche, O., 2013. Bank capital: lessons from the financial crisis. J. Money, Credit Banking 45, 1147–1164.
European Central Bank, 2014. Experience with foreign currency liquidity providing central bank swaps. Monthly Bull. (August) 65–82.
European Investment Bank. Banking in central and eastern Europe and Turkey - challenges and opportunities.
Everaert, G., Che, N., Geng, N., Gruss, B., Impavido, G., Lu, Y., Saborowski, C., Vandenbussche, J., Zeng, L. (2015) Does supply or demand drive the credit cycle? evidence from central, eastern, and southeastern Europe, IMF Working Paper WP/15/15.
Fratzscher, M., Lo Duca, M., Straub, R., 2013. On the international spillovers of US quantitative easing. European Central Bank Working Paper Series 1557.
Fidrmuc, J., Hake, M., Stix, H., 2013. Households' foreign currency borrowing in central and eastern Europe. J. Banking Finance 37, 1880–1897.
Goldberg, L.S., Kennedy, C., Miu, J., 2011. Central bank dollar swap lines and overseas dollar funding costs. FRBNY Econ. Policy Rev. 3–20 (May).
Huang, R., Ratnovski, L., 2011. The dark side of bank wholesale funding. J.Financ. Intermediation 20 (2), 248–263.
International Monetary Fund, 2010. global financial stability report sovereigns, funding, and systemic liquidity, World Economic and Financial Surveys, October 2010
Ivashina, V., Scharfstein, D., 2010. Bank lending during the financial crisis of 2008. J. Financ. Econ. 97, 319338.
López-Espinosa, G., Moreno, A., Rubia, A., Valderrama, L., 2012. Short-term wholesale funding and systemic risk: a global CoVaR approach. J Banking Finance 36 (12), 3150–3162.
Luca, A., Petrova, I., 2008. What drives credit dollarization in transition economies? J. Banking Finance 32, 858–869.
Moessner, R., Allen, W.A., 2013. Central bank swap line effectiveness during the euro area sovereign debt crisis. J. Int. Money Finance 35, 167–178.
Yesin, P., 2013. Foreign currency loans and systemic risk in Europe. Fed. Res. Bank St Louis Rev. 95 (3), 219–236.
Wooldridge, J.M., 2003. Cluster-sample methods in applied econometrics. Am. Econ. Rev. 93 (2), 133–138.