

II. SWEDEN AND THE GLOBAL BANKING SYSTEM: LINKS AND VULNERABILITIES¹

The links of both Swedish borrowers and Swedish banks with the global banking system are important but different in nature. While Swedish borrowers draw from a relatively large number of creditors, Swedish banks lend predominantly to Nordic and, to a smaller degree, Baltic borrowers. An important implication is that events triggering (large enough) credit losses in these key markets would come with significant pressures to deleverage and reduce lending in Sweden, with potentially severe real economic repercussions. At the same time, good policies that secure the soundness of Swedish international banking groups will benefit borrowers not only in Sweden but across the region.

A. Introduction

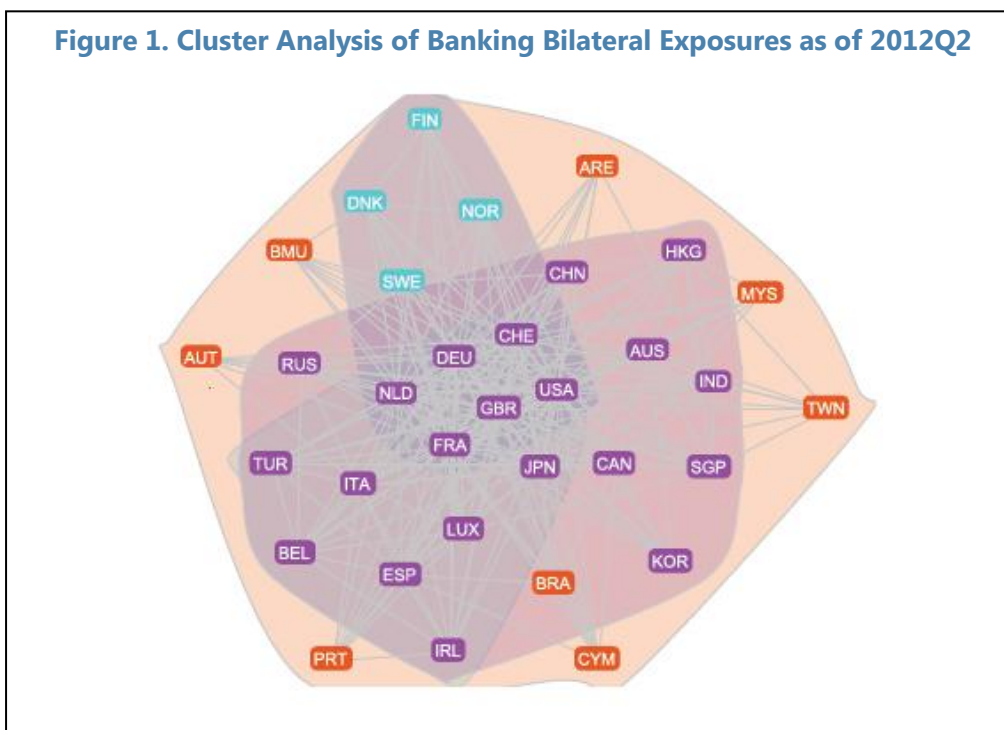
1. Analyzing the role of both Swedish borrowers and creditors within the global banking system is important. The recent financial crises highlighted the role of financial linkages between borrowers and creditors across countries and regions. In this context, this chapter analyzes the nature and intensity of Swedish borrowers' links to foreign banks as well as the exposure of Swedish banks to foreign borrowers.

2. Sweden plays a central role within the Nordic banking system and has important financial linkages with other global banking centers. Based on Cerutti (2013)'s measurement of both borrowers' foreign banking exposures and creditor banks' foreign credit exposure (see Appendix I), ongoing Fund work on financial interconnectedness using network analysis has identified a Nordic banking sub-cluster (see Figure 1).² The banking linkages between Nordic countries are strong enough (as of mid-2012) that the four Nordic countries are part of the same cluster (blue shaded names), together with the six main worldwide banking centers (US, UK, Switzerland, France, Netherlands and Germany). Nevertheless, Nordic countries' banking ties are not as strong with other countries, so they are not part of other clusters (e.g. red and orange shaded areas). The fact that Sweden is closer to the center in the figure reflects its greater centrality with respect to the other Nordic countries.

¹ Prepared by Eugenio Cerutti (RES).

² The network clustering analysis is based on a common algorithm (Palla et al., 2005), which identifies groups of mutually interconnected countries. Through their common members, these small groups are joined—like elements of an interlocking chain—into larger clusters (shaded areas). The links of the global banking network were measured by combining BIS Consolidated banking statistics and bank-level data as explained in the rest of the chapter and Appendix I.

Figure 1. Cluster Analysis of Banking Bilateral Exposures as of 2012Q2

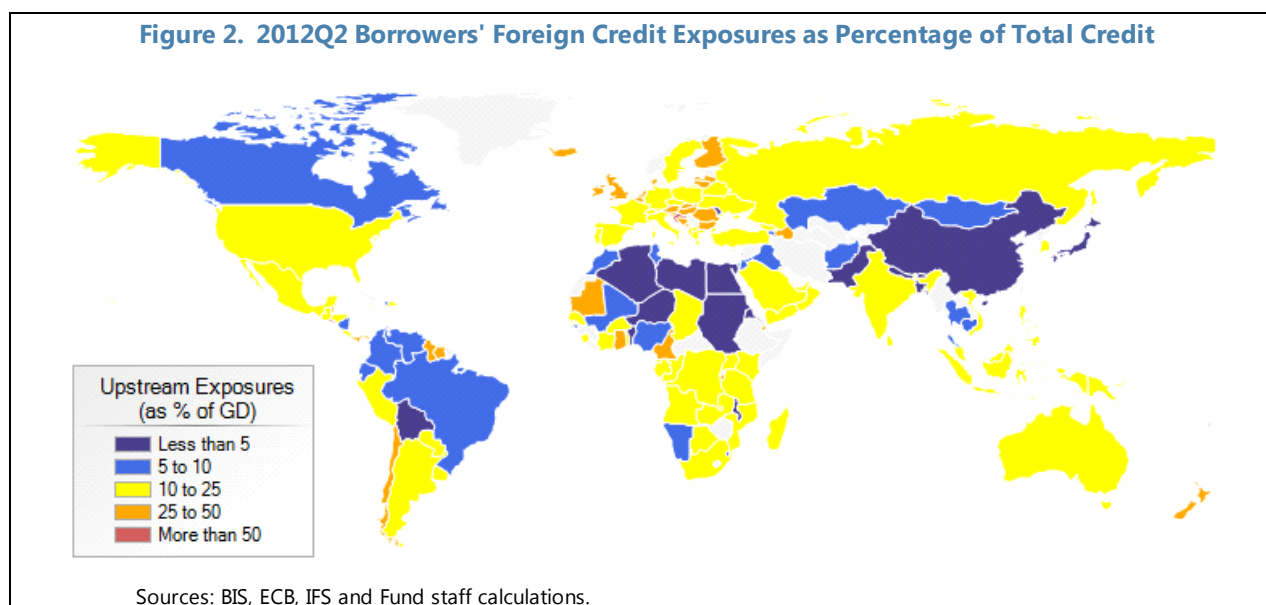


3. While Swedish borrowers are behind the banking linkages with main global banking centers, Swedish banks' cross-border lending establishes links to the Nordics. The rest of the chapter presents a detailed analysis of Swedish borrowers' foreign banking exposures and Swedish creditor banks' foreign credit exposure. In general, the analysis shows that not only are Swedish borrowers relatively less exposed to foreign bank credit than the rest of the Nordic countries and many European countries, but also that their exposure is more diversified across several banking systems. However, from the creditor perspective, Swedish banks constitute a very exposed banking system (e.g. the second most exposed banking system to foreign borrowers in terms of GDP or banks' Tier I capital) and are especially concentrated on Nordic borrowers.

B. Swedish Borrowers' Foreign Bank Linkages

4. Swedish borrowers' foreign banking exposures can be measured by combining BIS data and bank-level data. Swedish borrowers' foreign banking exposures are the result of both direct cross-border borrowing from international banks (e.g. a German bank directly lending to a Swedish corporation) and the proportion of lending by foreign affiliates operating in Sweden that depend on their parent banking system. The BIS consolidated banking statistics provide an international comparable proxy of these risks, but they do not take into account international banks' organizational and/or funding structure of funding affiliates, and thus overstate vulnerability levels. Foreign affiliates' (branches and subsidiaries) funding models are not necessarily fully dependent on parent banks or foreign funding sources. Local resident domestic customer deposits are often the main funding source of subsidiaries, and they do not constitute foreign rollover risks. The role of local deposit funding in foreign subsidiaries' claims can be captured by combining affiliates bank level data and BIS data (see Appendix I).

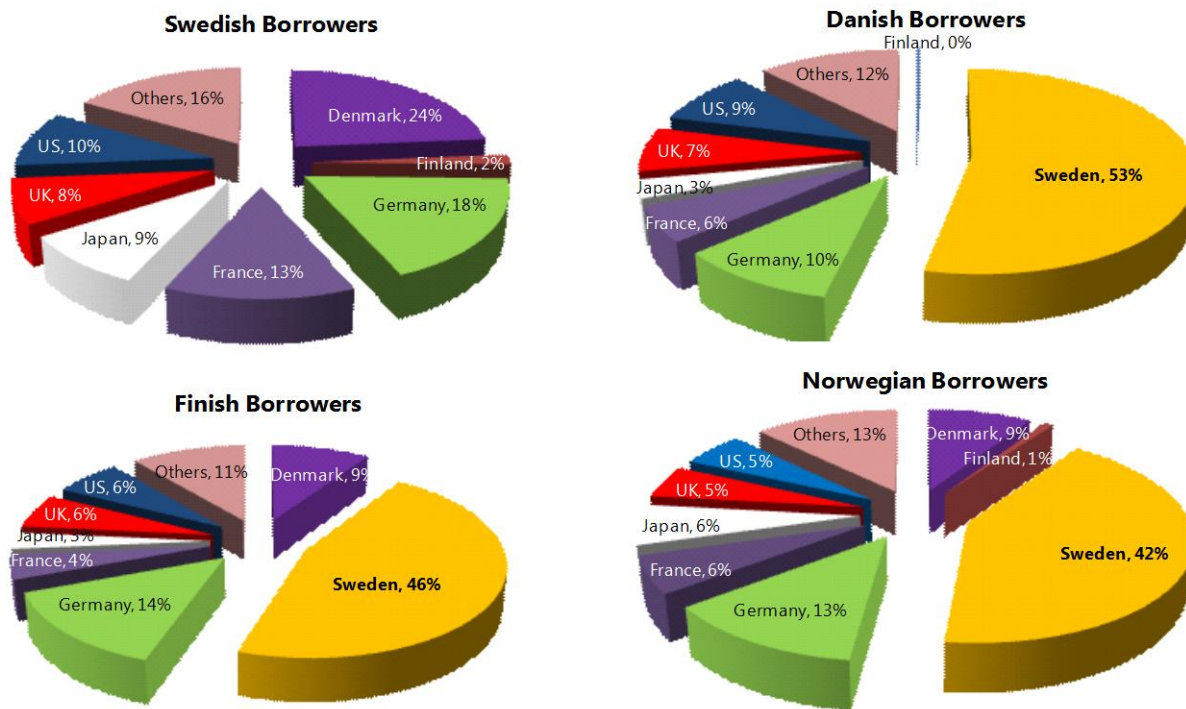
5. Swedish borrowers' foreign credit exposure is low. At about 21 percent of the total credit received by non-bank sector borrowers, it falls well short of the exposure levels of several countries in Eastern Europe and even the other Nordic countries (see Figure 2). The countries with the highest levels of exposure as a percentage of domestic and foreign bank credit to the non-bank sectors are Luxemburg (76 percent of total non-bank credit), Croatia (51 percent), Hungary (47 percent), Romania (46 percent), and Serbia (43 percent). Among Nordic countries, the most exposed countries are Finland (44 percent) and Denmark (34 percent). Most of the foreign credit exposure of Swedish borrowers originates in direct cross-border borrowing from international banks. Only in the case of the Danish banking systems, do Swedish borrowers have a strong link with foreign subsidiaries operating in Sweden (see NRR Analytical Notes, Chapter III).



6. Swedish foreign borrowing is also more diversified than other Nordic borrowers.

Unlike the rest of the Nordic countries, where more than $\frac{1}{2}$ of borrowers' foreign banking exposures are within Nordic banking systems, only $\frac{1}{4}$ of the total borrowers' foreign exposure originates in regional Nordic banks (see Figure 3). The main foreign banking creditor of Swedish borrowers is the Danish banking system (24 percent of the total foreign credit exposure), while the exposure to Finnish banks is minimal (around 2 percent). Other Nordic countries borrow mostly from Nordic banking sectors due to the large penetration of Swedish banks (e.g. Swedish banks represent 53 percent of total Danish borrowers' foreign credit sector exposure; 46 percent in the case of Finnish borrowers, and 42 percent in the case of Norwegian borrowers). Outside the Nordic region, Swedish borrowers' exposures originate in operations with German banks (18 percent of total foreign credit exposure), French banks (13 percent), and US banks (10 percent).

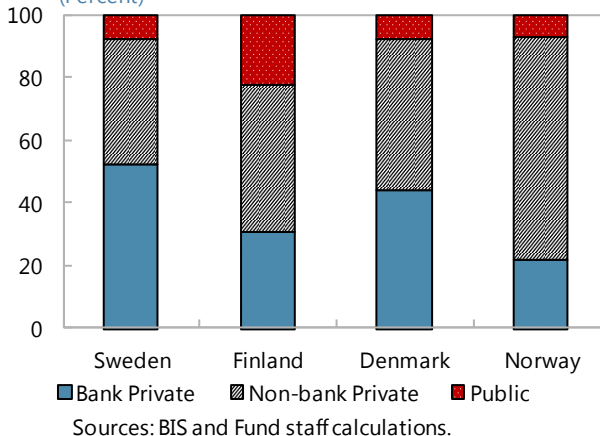
Figure 3. 2012Q2 Nordic Borrowers' Foreign Credit Exposure by Country



Sources: BIS, ECB, IFS, and Fund staff calculations.

7. Domestic banks are the main borrowers of foreign credit. More than 50 percent of Swedish borrowers' foreign banking credit during 2010Q2 was received by Swedish domestic banks, mostly originating from Danish, UK, and US banks. This is not the case in other Nordic countries, where non-bank private sectors are the main borrowers (see Figure 4). The level of Swedish bank funding from the foreign bank sources covered by BIS data is about 6 percent of total Swedish bank liabilities.

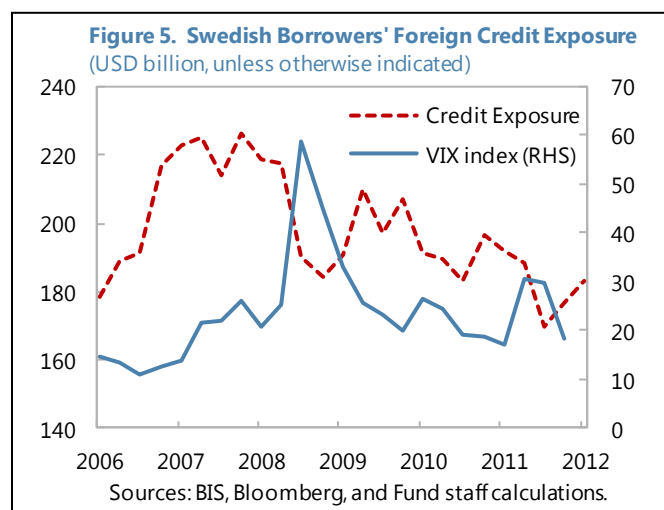
Figure 4. Borrowers' Foreign Credit Exposure by Sector (Percent)



8. The evolution of Swedish borrowers' foreign credit exposures has been highly dependent on global financial conditions. Since the March 2008 peak before the financial crisis, Swedish borrowers' foreign credit exposures have decreased by 20 percent as of 2012Q2.³ Although smaller, this decline has followed the evolution in other European countries. The evolution of Swedish borrowers' foreign credit exposures has been highly correlated with global financial conditions, as Figure 5 shows with respect to the VIX. This is in line with evidence found in other countries. Moreover, for Swedish borrowers, the sensitivity to changes in global financial variables is three times higher than the average of other countries (See Appendix II).

9. In addition to global risk aversion, systemic crises in creditor banking systems and the characteristics of the form of borrowing also mattered for Swedish borrowers. The evidence for the other drivers, in addition to global financial conditions, is

more mixed, but shows that several channels have been as important as for other borrowers. From whom countries borrowed (e.g., systemic banking crisis in creditor banking systems translated into a decline in borrowers' foreign banking exposures) and how they borrowed (rollover of direct cross-border lending was much more difficult than of affiliates' lending) would still be significant for Sweden. However, the evolution of Swedish foreign bank borrowing was not clearly related to Swedish GDP as in other countries (See Appendix II).



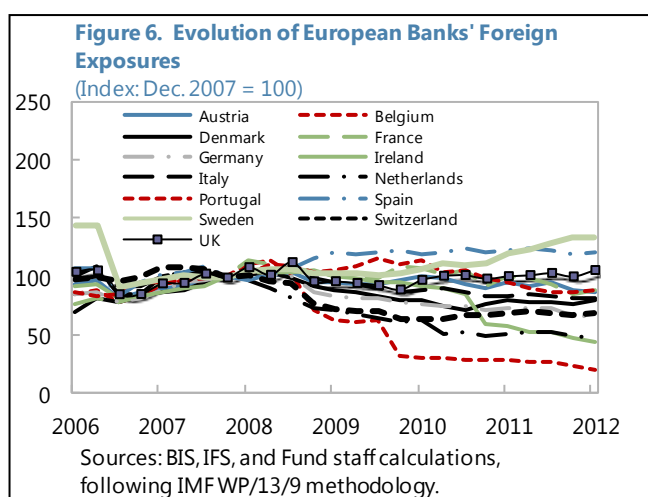
C. Swedish Banking System's Foreign Credit Exposure

10. As in the previous section, the level of exposures of a banking creditor system to foreign borrowers can be measured by combining BIS data and bank-level data. The level of exposure to borrower countries is often overstated by using simple BIS CBS balance sheet claims, which captures, under the concept of foreign claims, both direct cross-border and foreign affiliates' claims. Although the parent bank exposure to its own direct cross-border and branch's claims are uncapped and equal to total claims, the exposure to a subsidiary is not legally equal to the total claims originating in that subsidiary. The legal exposure to a subsidiary in a host country is limited to the capital incorporated in that subsidiary plus non-capital debt owed by the subsidiary to the parent bank. Following Cerutti (2013), the analysis developed in this section takes into account this fact, and measures a creditor country's exposure to countries that borrow from its banks (see Appendix I for more methodological details).

³ Exchange rate and coverage break-in-series adjusted series following methodology developed in Cerutti (2013). See Box 1 for a short explanation of the adjustments performed.

11. Swedish banks are second only to Swiss banks in their cross-border exposure. The Swedish banks' foreign credit exposures represent about 150 percent of GDP or about 1000 percent of Tier I capital buffers (see Table 1). These figures are only surpassed by Swiss banks (260 percent of GDP and almost 2000 percent of banks' Tier I capital), and very close to UK banks (145 percent of GDP and 925 percent of Tier I). The Swedish banks' exposures are mostly the result of the ample network of subsidiaries in Nordic and Baltic countries, with only about 20 percent originating on direct cross-border lending. Non-Swedish Nordic and Baltic borrowers represent about 56 and 5 percent of total Swedish banks' foreign credit exposures, respectively.

12. Unlike most European banking systems, Swedish banks have increased their adjusted cross-border banking claims after the crisis. Swedish banks' cross-border claims increased by about 30 percent since 2010 (see Figure 6).⁴ The analysis of the drivers during 2006–12 indicates that the evolution of Swedish banks' foreign credit exposures could be explained by the fact that the Swedish banking sector did not experience a systemic banking crisis during the period. Also, demand in the Nordic countries seems to have played a role once estimations allow for different GDP elasticities for Sweden (see Appendix II for econometric analysis). This seems to be driven by the increased lending to Nordic countries (share increase from 61 percent of the foreign loan portfolio in 2010 to 69 percent in 2012) and the decrease in lending to Baltic countries (from 11 percent in 2010 to 8 percent in 2012Q2). This increasing concentration to the Nordic countries (85 of total lending if we include lending to Swedish domestic borrowers) highlights the risks of shocks to the region.



⁴ These figures are exchange rate and break-in-series adjusted as detailed in Box 1. Another point of reference, during the same period, is the 20 percent increase in Swedish banks' total assets. The latter are not exchange rate adjusted, so even though they are not strictly comparable, they also indicate Swedish bank asset expansion during the period.

Table 1. Banks' Foreign Credit Exposures (Downstream Exposure) as of June 2012 1/

BIS reporting country	On-balance sheet exposure (USD bil.)	of which cross-border (%)	Total On-balance sheet as % of GDP	Total On-balance sheet as % of banks' assets	Total On-balance sheet as % of banks' Tier I
Australia	558.7	34	36.2	17.8	389.2
Austria	363.5	75	91.6	33.0	550.2
Belgium	243.1	71	50.3	34.9	821.5
Brazil	95.6	76	4.0		
Canada	725.9	43	41.0	21.1	488.5
Chile	5.6	97	2.1		
Denmark	225.3	45	72.9	22.0	405.8
Finland	20.7	96	8.2	11.1	209.2
France	2498.3	55	95.3	29.8	678.4
Germany	2554.5	80	75.1	26.0	655.6
Greece	77.4	74	30.9	18.2	
Hong Kong	41.1	100	15.9		
India	42.5	75	2.2		
Ireland	146.5	27	70.3	31.2	378.5
Italy	715.8	43	35.7	21.6	367.6
Japan	2777.1	83	46.4	32.3	651.1
Luxembourg	49.0	97	85.5	55.4	805.7
Mexico	3.9	100	0.3		
Netherlands	973.9	45	125.7	30.5	695.2
Panama	13.7	100	39.2		
Portugal	107.1	61	50.1	21.6	297.5
Singapore	265.7	75	99.2		
Spain	1197.5	22	88.3	25.6	522.7
Sweden	780.6	21	148.6	37.8	1009.4
Switzerland	1659.2	45	262.3	64.6	1988.4
Taiwan	216.3	89	46.4		
Turkey	20.2	85	2.6		
United Kingdom	3527.7	46	143.5	35.0	930.1
United States	2896.9	57	18.5	24.2	279.2

Sources: BIS and Fund staff calculations following IMF WP/13/9 methodology.

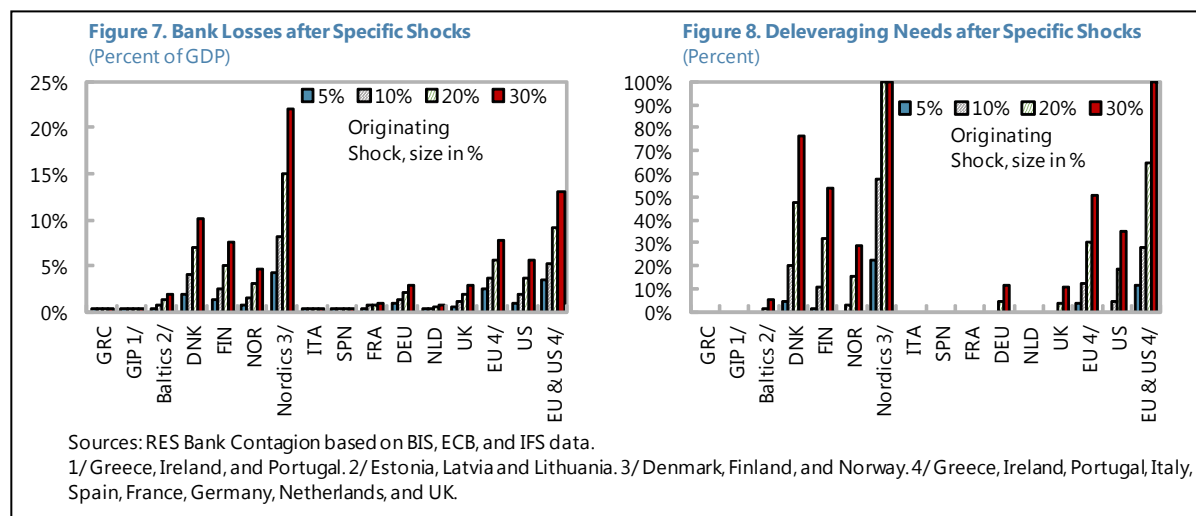
1/ Based on BIS data at ultimate risk basis, except immediate basis reported for Brazil, Denmark, Hong Kong, Mexico, Panama, and Taiwan.

D. Scenario Analysis

13. Scenario analysis illustrates the potential impact of losses from foreign exposures.

Building on the RES/MFU Bank Contagion Module, a spillover analysis is conducted to simulate the effects of losses on international banks' claims on particular countries and sectors.⁵ In the simulation, a first round considers losses on assets that deplete bank capital partially or fully. It relies on assumptions about the percentage loss on particular types of assets (e.g., claims on the public sector, banking sector, and non-bank private sector of an individual country or group of countries). In the second round, if losses are large, banks are assumed to restore their capital adequacy to at least a certain threshold (e.g., 9 percent Core Tier I capital in the case of European banks) through deleveraging (i.e., sale of assets and refusal to roll-over existing loans). In the third round, banks are assumed to reduce their lending to other banks (funding shocks), potentially triggering fire sales, further deleveraging, and additional losses at other banks. Final convergence is achieved when no further deleveraging occurs.

14. A shock in Greece, Ireland, or Portugal would have only a small direct impact. The direct exposure of the Swedish banking sector to the sovereign and private sectors in Greece, Ireland, and Portugal (GIP) is so low that there is no notable loss to Swedish banks even if they have to withstand simultaneously very high 30 percent losses on those claims (see Figure 7). In particular, such bank losses would not have any measured impact on the ability of Swedish banks to extend credit to the economy, since capital buffers would be able to cover them and there would be no need for deleveraging (see Figure 8). However, the analysis is performed at the aggregate level and thus hides potentially larger losses for individual banks. The latter may cause a knock on effect to other banks, so aggregate results should be interpreted with care.



⁵ For more details on the spillover analysis and its limitations, see Cerutti, Claessens, and McGuire (2011). Due to lack of data granularity, this type of analysis is seeking to identify the largest vulnerabilities to specific generic assumed shocks, but does not constitute a full bank level stress test exercise.

15. Significant losses could be incurred due to exposures to Nordic and, to a lesser degree, Baltic countries. In contrast with the earlier example, Figures 7 and 8 show how the Swedish banking sector is more vulnerable to losses recorded on Baltic and Nordic assets. For example, a relatively high 30 percent decline in the asset value held on Baltic borrowers could result in losses for Swedish banks of around 1¾ percent of GDP. In the absence of corrective policy measures (e.g. recapitalizations), Swedish banks would need to slightly deleverage in order restore capital thresholds. In contrast, much smaller shocks in the Nordic markets would have a much larger effect on Swedish banks. For example, a level 10 percent loss in Denmark or Finland would trigger large Swedish bank losses that current capital buffers would not be able to offset, forcing double digit bank deleveraging. In turn, this could have severe second round effects for overall GDP growth (Dell’Ariccia et al., 2008). The large impact on credit availability underpins the impact on Swedish banks—which would have cut domestic credit to restore the capital ratio threshold—and the importance of exposure to cross-border activities of Danish banks active in Sweden (Danish banks would be responsible for about 10 percent of GDP deleveraging, out of the total impact of 42 percent when domestic deleveraging is accounted for in the Denmark shock presented in Table 2).

Table 2. Spillovers to Sweden from International Banks’ Exposures as of June 2012

	Shock Originating From Magnitude 1/	Deleveraging Need 2/	Swedish Lenders’ Losses (percent GDP)	Impact on Credit Availability (percent of GDP) 3/
Greece	30	0.0	0.0	0.0
GIP 4/	30	0.0	0.1	0.1
Baltics Countries 5/	30	5.3	1.8	8.7
Denmark	10	19.6	4.0	42.3
Finland	10	10.6	2.5	17.9
Norway	10	2.7	1.5	4.4
Nordic Countries 6/	10	57.2	8.1	104.5
Italy	10	0.0	0.0	0.3
Spain	10	0.0	0.0	0.4
France	10	0.0	0.6	3.9
Germany	10	0.0	1.3	5.4
Netherlands	10	0.0	0.3	0.9
UK	10	0.0	1.1	2.1
European Countries 7/	10	12.4	3.5	34.1
US	10	4.0	1.8	8.2
European Countries & US 7/	20	64.6	9.0	127.7

Sources: RES/MFU Bank Contagion Module based on BIS, ECB, and IFS data.

1/ Magnitude denotes the percent of on-balance sheet claims (all borrowing sectors) that default.

2/ Deleveraging need is the amount (in percent of Tier I capital) that needs to be raised through asset sales in response to the shock in order to meet a domestic banking sector Tier I capital asset ratio of 10 percent, expressed in percent of total assets and assuming no recapitalizations.

3/ Reduction in domestic and foreign bank credit to Swedish borrowers due to the impact of the analyzed shock in international banks’ balance sheets, assuming a uniform deleveraging across domestic and external claims.

4/ Greece, Ireland, and Portugal.

5/ Estonia, Latvia, and Lithuania

6/ Denmark, Finland, and Norway

7/ Greece, Ireland, Portugal, Italy, Spain, France, Germany, Netherlands, and UK

16. A general crisis in Europe would also trigger important spillovers to Sweden. For example, a 10 percent loss on claims on either Italian, Spanish, French, German, Dutch, or UK borrowers would trigger losses up to 1¼ of GDP, although these could be absorbed with current Swedish banks' aggregate capital buffers. According to our model, most of the impact on Sweden would be the result of the deleveraging of foreign banks (especially in the case of losses on German assets). Nevertheless, if those losses in each country occurred simultaneously, the impact would be large enough to trigger bank deleveraging across the world.

17. The indirect effects associated with a default in any country are likely to be much larger, especially if they have impact on Sweden's access to wholesale funding. Although the simulations take into account second-round deleveraging effects, the results abstract from likely effects on confidence, asset prices, and implications of potential defaults.

E. Conclusions

18. The analysis highlights the large cross-border exposures of Swedish banks, in particular to the Nordic markets. These exposures to Nordic countries, even when each country is considered individually, are larger than for all the Baltic countries as a group, and this concentration in Nordic borrowers has increased in recent years. This reinforces the advantages of strong financial sector policies across the Nordic region highlighted in the 2013 NRR report (see 2013 NRR Analytical Notes, Chapter II). This includes adequate capital levels and macroprudential measures such as minimum risk weights for mortgages and lower LTV ratios in Sweden and across the region to prevent the likelihood and reduce the potential impact of house price corrections on banks' balance sheets. Regional coordination on tackling these vulnerabilities would help to avoid regulatory arbitrage within the region.

19. Addressing vulnerabilities on Swedish banks' liability side will also be important. The analysis has shown that the Swedish banking sector is dependent on foreign external funding, which has been especially sensitive to global financial conditions. This suggests that a re-emergence of strong global risk aversion, for example, following a deepening of the euro area crisis, would impact Swedish banks beyond their direct asset exposure. Along the same line, a large adverse shock in Sweden or the Nordic region (e.g., a sudden drop in domestic demand) could open the door for increased uncertainty amongst international investors with regard to the strength of Swedish banks, which could trigger a sudden stop in Swedish external bank funding. A regulatory measure to decrease vulnerabilities from banks' liability side would be to ensure that Basel III Net Stable Funding Ratio targets are met in 2018 (or before) by all banks. Formal minimum intermediate targets would be desirable in this context.

References

- Avdjiev, S., Z. Kuti, and E. Takats, 2012, "The Euro Area Crisis and Cross-border Bank Lending to Emerging Countries." *BIS Quarterly Review*, December 2012.
- Cerutti, E., 2013, "Banks' Foreign Credit Exposures and Borrowers' Rollover Risks: Measurement, Evolution and Determinants," *IMF Working Paper* No. 13/9.
- Cerutti, E., S. Claessens, and P. McGuire, 2011, "Systemic Risks in Global Banking: What Available Data Can Tell and What More Data are Needed?" *IMF Working Paper* No. 11/222. Forthcoming in *"Systemic Risk and Macro Modeling"*, edited by M. Brunnermeier and A. Krishnamurthy, NBER.
- Cerutti, E., G. Dell'Ariccia, and S. Martinez Peria, 2007, "How Banks go Abroad: Branches or Subsidiaries?" *Journal of Banking and Finance*, Vol. 31, No. 6, p. 1669–692, June.
- Cerutti, E., F. Ohnsorge, and K. Youssef, 2013, *Global Banking Networks: Has The Crisis Changed Them?* Mimeo.
- Claessens, S., G. Dell'Ariccia, D. Igan, and L. Laeven, 2010, "Cross-Country Experiences and Policy Implications from the Global Financial Crisis," *Economic Policy*, Vol. 25, Issue 62, pp. 267–93.
- Dell'Ariccia, G., E. Detragiache, and R. Rajan, 2008, "The real effect of banking crises," *Journal of Financial Intermediation*, vol. 17(1), pages 89–112, January.
- Garcia-Herrero, A., and M. S. Martinez-Peria (2007): "The Mix of International Banks' Foreign Claims: Determinants and Implications," *Journal of Banking and Finance*, Vol. 31, pp. 1613–31.
- Kamil, H., and K. Rai, 2010, "The Global Credit Crunch and Foreign Banks' Lending to Emerging Markets: Why Did Latin America Fare Better," *IMF Working Paper* No. 10/102 (Washington: International Monetary Fund).
- McGuire, P., and N. Tarashev, 2008, "Bank Health and Lending to Emerging Markets," *BIS Quarterly Review*, pp. 67–80, December.
- Palla, G., I. Derényi, I. Farkas, and T. Vicsek, 2005, "Uncovering the overlapping community structure of complex networks in nature and society", *Nature* 435, 814–818.

Box 1. Adjusting BIS Statistics for Coverage Break-in-Series and Exchange Rate Movements

The fact that BIS Consolidated Banking Statistics (CBS) at ultimate borrower basis is available since mid 2005 makes performing time series analysis very appealing for depicting the recent crisis. Nevertheless, two adjustments must be performed in order to avoid misleading conclusions: (i) the BIS CBS break-in-series are not only numerous, but also significant; and (ii) claims in US dollars could change from one period to another even if the actual underlying position remained unchanged since BIS CBS claims in other currencies are converted by reporting banks into US dollars at end-of-quarter exchange rates. The magnitude of these adjustments is important (almost up to 15 percent of total foreign claims in 2006) as shown in the figure below. See Cerutti (2013) for more details.

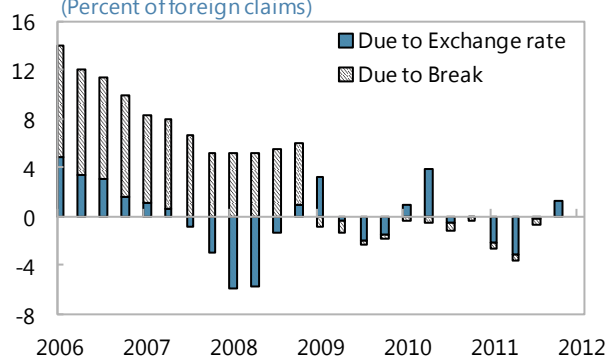
Adjustment for Coverage Break-in-Series

BIS reports 84 series breaks during 2006–12 in BIS consolidated banking statistics at ultimate borrower risk basis. About 61 breaks are due to mergers and acquisitions among foreign banks, thus reflect a change in exposure levels at the bilateral borrower-creditor level but not across all BIS reporting bank level (e.g. the acquisition of a Belgium sub in Turkey by a French bank would not change the total claims on Turkey). Other 23 coverage break-in-series are driven by an expansion of the banking sector coverage (e.g., increase in reporting population due to inclusion of former investment banks and merger of domestic banks that triggered a consolidation of foreign claims, etc.). This type of coverage break-in-series deserves special attention because the increases in exposure levels were already present before they started reporting to BIS. An important example is the US 2009Q1 USD 1,334 billion break-in-series, when the former investment banks become banks (e.g. Goldman Sach's foreign claims existed before 2009Q1). Performing time series analysis without correcting the original BIS data would lead to wrong conclusions (e.g. both US cross-border and US local claims have decreased during the crisis not increase as the unadjusted series would indicate). The fact that BIS reports the value of the series without the break helps offset the break impact.

Adjustment for Exchange Rate Variations

The impact of exchange rate movements was important during the crisis, when there was high volatility among countries' exchange rates. Three corrections are performed to address this problem at the bilateral creditor national banking system-borrower country level. First, the domestic-currency denominated local affiliates claims are corrected following the bilateral US dollar domestic currency exchange rate. The domestic-currency denominated local affiliates' claims are proxied by using its share of total BIS CBS foreign claims at immediate borrower basis. Second, at the same time, this procedure allows for the identification of the amount of foreign-currency denominated local affiliates' claims, which are assumed to be in Euros in Europe and US dollars in the rest of the countries. Finally, bilateral CBS cross-border claims positions are adjusted using, as proxy, the currency breakdown currency (among US. Dollar, Euro, British Pound, Japanese Yen, and Swiss Francs) available from the BIS locational banking statistics (LBS).

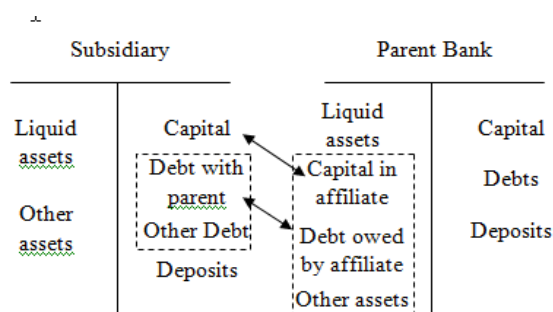
Break-in Series and Exchange Rate Adjustments in Foreign Claims
(Percent of foreign claims)



Sources: BIS, IFS, and Fund staff calculations, following IMF WP/13/9 methodology.

Appendix I. Measuring Banks' Foreign Credit Exposures and Borrowers' Reliance on Foreign Banking Credit

Banks' Foreign Credit Exposures (Downstream Vulnerability): It is possible to obtain the quantification of cross-border lending and off-balance sheet positions from BIS data. However, using BIS data on affiliates claims likely overstates the true exposure of parent banks to their subsidiaries, which is limited to the capital incorporated in the subsidiary plus other non-equity lending from the parent bank to the subsidiary (see figure below).¹



Therefore, a creditor country i downstream exposure would be equal to $A_{ij} + B_{ij} + C_{ij} + D_{ij}$ where: $A_{ij} = \text{Crossborder claims}_{ij}$ captures the direct cross-border exposure from creditor country i on debtor country j ; $B_{ij} = \text{total_assets}_{ij}^{subs} - \text{deposits}_{ij}^{subs} + \text{total_assets}_{ij}^{branch}$ captures the exposure to subsidiaries and branches, taking into account the legal differences between them; $C_{ij} = \text{local claims}_{ij} - \sum_{subs \& branch} \text{total_assets}_{ij}$ represents the non-identified exposure by bank level

data with respect to BIS reported affiliates claims (i.e. individual bank-level data on branches is especially often not reported in many countries); and

$D_{ij} = \text{derivatives}_{ij} + \text{guarantees}_{ij} + \text{credit_commitments}_{ij}$ capture off-balance sheet exposure from country i banks on country j based on BIS data.

The level of downstream exposure can be combined with the probability of crisis (e.g. as produced by VEA and VEE) in a borrowing countries and with the loss-given default (LGD) estimations in order to estimate potential expected losses. The downstream indicator (D_i) is estimating those expected losses as percentage of GDP or total banking sector assets in country i as follows:

$$D_i = \sum_{j=1}^N \frac{A_{ij} + B_{ij} + C_{ij} + D_{ij}}{Z_i} V_j$$

¹ For more details on the differences between branches and subsidiaries, see Cerutti et al (2007): "How Banks Go Abroad: Branches for Subsidiaries? Journal of banking and Finance, 2007, Vol. 31, pp. 1669–1962.

where: Z_i is a scaling factor (GDP or total banking sector assets in country i); and $V_j = \text{Prob crisis}_j * LGD_j$ is the probability of a crisis in borrowing country j times the loss given default in country j .²

Borrowers' Reliance on Foreign Banking Credit (Upstream Vulnerability): For each borrowing country, its exposure to foreign bank credit is a function of the direct cross-border lending from banks in upstream creditor countries, and the lending by foreign affiliates funded by their creditor countries' parent banks. In this context, a borrowing country j *upstream exposure* can be captured by:

$$\text{Upstream Exposure}_j = \text{Crossborder claims}_{ij} + \text{Local claims}_{ij} * (1 - \text{Min}(\text{deposit loan_ratio}_{ij}, 1))$$

where: $\text{Crossborder claims}_{ij}$ captures the volume of direct cross-border claims from country i on country j ; Local claims_{ij} the volume of affiliates (subsidiaries and branches) claims of parent banks from country i on country j ; and $1 - \text{Min}(\text{deposit loan_ratio}_{ij}, 1)$ is a proxy of the proportion of loans not financed by local consumer deposits. The higher the deposit to loan ratio, the lower is the share of local claims financed by parent bank resources and/or wholesale financing, which is implicitly assumed to be correlated with the parent bank problems. As described in the downstream analysis, the amount of lending by affiliates funded by their parent banks cannot be directly measured since the available bank level balance sheet data from Bankscope is not detailed enough to identify all parent banks' non-equity claims. Therefore, the upstream indicator could be considered as an upper bound.³

² The loss given default ratio is not applied to banks' liquid assets in the calculation of creditors' exposure to their subsidiaries and branches. For example, defining $\text{total_assets} = \text{liquid_assets} + \text{other_assets}$, then

$$B_{ij} LGD_j = \min(\text{other_assets}_{ij}^{sub} * LGD_j, \text{total_assets}_{ij}^{subs} - \text{deposits}_{ij}^{subs}) + \text{other_assets}_{ij}^{branch} * LGD_j$$

³ In the cases where affiliates' bank level data is not available, borrowing country national deposit to loan ratio is used in order to have a larger country coverage. Using affiliates' total assets minus deposits, like in the case of the downstream exposure to subsidiaries, as the proxy of the amount of lending by affiliates funded by their parent banks produce similar results but lower country coverage.

Appendix II. Drivers of Foreign Banking Exposures¹

Drivers of Creditor Banks' Foreign Credit Exposures

The estimations show that most variables have the expected sign and are statistically significant when considered individually (see columns 1 to 6 in Table A1). Higher global risk aversion and the presence of systemic bank crisis in creditor banking systems are linked with a reduction in banks' foreign credit exposures. An increase in borrower countries' GDP growth or in the deposit to loan ratio of the creditor banking systems display a positive significant relationship with variations in

2006Q2-2012Q1 - Panel OLS with Fixed Effects - Dependent variable: Change in Adjusted Foreign Credit Exposure (in percent)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ΔGDP_{ijt}	1.391** (0.693)						0.458 (0.934)	-0.998 (1.110)	0.759 (0.629)	0.547 (0.799)
Cred_Systemic_Crisis		-4.471*** (0.997)					-3.723*** (1.042)	-3.152** (1.266)	-2.226** (0.951)	-3.046*** (0.985)
Cred_DLR			10.99* (5.633)				8.448 (5.893)	7.386 (5.755)	10.59 (7.352)	7.513 (6.213)
Cred_CB_Share				0.0465 (0.0697)			0.0159 (0.0673)	-0.0283 (0.0709)	-0.005 (0.068)	0.029 (0.069)
VIX					-0.104** (0.0526)		-0.0517 (0.0789)	0.441 (0.6513)		
TED Spread						-0.0044 (0.0073)	-0.0021 (0.0055)	-1.910 (1.3678)		
TED * Cred_Systemic_Crisis									-0.0369*** (0.0121)	
TED * Cred_DLR									-0.0297 (0.0323)	
TED * Cred_CB_Share									0.0369 (0.0445)	
VIX * Cred_Systemic_Crisis										-0.136** (0.061)
VIX * Cred_DLR										-0.165 (0.189)
VIX * Cred_CB_Share										0.166 (0.319)
Quarterly Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Time Fixed Effects	No	No	No	No	No	No	No	No	Yes	No
Creditor Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	622	622	622	622	622	622	622	622	622	622
Number of Creditor Banks	26	26	26	26	26	26	26	26	26	26
R2	0.082	0.092	0.081	0.074	0.084	0.074	0.102	0.164	0.111	0.109

Note: This table reports panel fixed effect described Cerutti (2013). Robust standard errors are in parentheses and they are clustered at the creditor banking system level. Asterisks denote significant of coefficients, with ***, **, * indicating significance at 1%, 5% and 10% level, respectively.

¹ For more details on the estimations and data used see Cerutti 2013 (IMF WP/13/0).

foreign credit exposures. Instead, the TED spread—the other global financial measured used—as well as the share of direct cross-border in total lending (Credit_CB_Share) do not display statistically significant correlations when considered individually.

Nevertheless, once all variables are estimated together in columns 7–10 of Table A1, it is clear that only two relationships seem to remain statistically significant. The presence of a systemic banking crisis in the creditor banking system is a good indicator of a decline in foreign credit exposures. A systemic banking crisis would trigger about a 3 percent decline in foreign credit exposures in a given quarter. This finding is robust to the introduction of time fixed effects (column 8), indicating that the explanatory power of the presence of a systemic banking crisis is not only based on the fact that most systemic banking crises started in the second half of the sample. In addition, when global financial variables are interacted with creditor systemic crisis, both an increase in global risk aversion or funding spreads would reinforce the fall in foreign credit exposures. At the peak of the global financial variables in our sample, the presence of a systemic banking crisis would be associated with a decline in foreign credit exposures of about 8 and 11 percent, depending if we use the specification with risk aversion (column 9) or ted spreads (column 10), respectively.²

In sum, the analysis highlights that creditor banking systems' foreign exposures were driven by the presence of bank systemic crisis and global financial conditions. The characteristic of the lending—through either direct cross-border or affiliate lending—does not seem to be as relevant. Similarly, demand factors in borrowing countries—at least the ones that we proxy with borrowers GDP growth—and the credit banks' funding structure characteristics do not seem to be statistically significant drivers.³

Allowing Different Coefficient Slopes for Sweden

In order to explore the possibility that the coefficients for Sweden could be different than the estimated for all countries, an interacted variable capturing each explanatory variable and a dummy for Sweden were introduced in Table A2 below. These results for Sweden—adding up the coefficient of each variable alone plus the interacted with Sweden dummy would illustrate Sweden slope—have to be very cautionary interpreted because the time series dimension of the panel is short (24 quarters).

In general, they indicate that the global financial conditions were not as important for Sweden. This is probably capturing the fact that Swedish banks increased their cross-border banking exposures at

² A one standard deviation increase in global financial variables, together with the presence of a systemic banking crisis, would be associated with a decline in foreign credit exposures of about 4½ percent.

³ Including other bank characteristics in the estimations was not possible for the full sample. At the cost of reducing ¼ of the sample and an imbalanced panel in terms of time coverage, the inclusion of creditor banks' Tier I ratio in the estimations seems to indicate that the level of bank solvency might have also played a role, with a positive and statistically significant coefficient (at 10 percent level). The results with respect to the importance of the presence of systemic banking crises and their interaction with global financial variables remain valid.

the end of 2011 and that they did not decrease much during 2008–09. In general the evidence for the other factors is mixed, and the reversal in the signs suggest the characteristic of the lending and the parent funding coefficient are driven by the fact that Swedish lend cross-border mostly through subs and that wholesale funding plays a big role. Once other factors are included in the regressions, Swedish borrowers GDP growth (proxy of demand) might explain the increase in Swedish banks' foreign credit exposures. This is likely driven by the performance of the Nordic countries in more recent years. Finally, the regressions highlight that the fact that Sweden did not experienced a systemic banking crisis played a role in their increase foreign credit exposure.

Table A2. Determinants of the Change in Banks' Foreign Credit Exposures (with Swedish Dummies)

2006Q2-2012Q1 - Panel OLS with Fixed Effects - Dependent variable: Change in Adjusted Foreign Credit Exposure (in percent)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ΔGDP_{ijt}	1.486** (0.725)						0.493 (0.988)
$\Delta GDP_{ijt} * SWE$	-1.599*** (0.582)						2.156*** (0.779)
Cred_Systemic_Crisis		-4.471*** (0.997)					-3.723*** (1.042)
Cred_Systemic_Crisis * SWE 1/		--					--
Cred_DLR			11.02* (5.654)				8.484 (5.976)
Cred_DLR * SWE			-81.40*** (23.61)				-422.08*** (31.17)
Cred_CB_Share				0.0707 (0.0671)			0.0382 (0.0649)
Cred_CB_Share * SWE				-0.5959 (0.0681)			-1.0585 (0.0657)
VIX					-0.1102** (0.0542)		-0.0588 (0.0813)
VIX * SWE					0.171*** (0.0539)		0.1959** (0.0821)
TED Spread						-0.0042 (0.0076)	-0.0012 (0.0056)
TED Spread * SWE						-0.0021 (0.0081)	-0.0011 (0.0068)
Quarterly Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	No	No	No
Creditor Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	622	622	622	622	622	622	622
Number of Creditor Banks	26	26	26	26	26	26	26
R2	0.082	0.092	0.081	0.074	0.084	0.074	0.108

Note: This table reports slightly modified version of the baseline panel fixed effect estimated by Cerutti (2013) due to the use of interacted terms to allow different slopes for Sweden. Robust standard errors are in parentheses and they are clustered at the creditor banking system level. Asterisks denote significant of coefficients, with ***, **, * indicating significance at 1%, 5% and 10% level, respectively. 1/ Not estimated since Sweden did not experienced systemic banking crisis.

Drivers of Borrowers' Foreign Banking Credit

The estimations in Table A3 show that a larger set of factors has a role in explaining the evolution of borrowers' foreign exposures than in the case of banks' foreign credit exposures.⁴ The reading of the results highlights that:

First, from whom a country borrows was important. Borrowing countries operating with creditor banking systems that were experiencing systemic banking crisis suffered a negative change in borrowers' foreign exposures (up to -12 percent if all creditor banking systems were through systemic banking crisis).⁵ This impact was larger during high TED spreads as highlighted in the interactive coefficient of column 8, indicating that countries were not fully able to substitute a creditor banking system in crisis with another. Instead, the negative impact of systemic banking crisis in creditor banking systems was lower, the higher the borrower deposit to loan ratio (see interaction coefficient column 9). This suggests that countries with domestic banking systems with lower exposure to non-deposit funding were able to insulate themselves better during the crisis. This is in line with Claessens et al. (2010) that show that banks' dependence on wholesale funding help to account for the amplification and global spread of the financial crisis.

⁴ Table A3 only includes TED spreads from global financial variables in order to present more interaction variables.

⁵ Although at a lower significance level, this finding is robust to the introduction of time fixed effects (column 7). The explanatory power of the proportion of systemic banking crisis in creditor banking systems is not only based on the fact that most systemic banking crises in creditor banking systems started in the second half of the sample. In addition, this is consistent with the evidence found by Avdjiev, Kuti and Takas (2012) that the deterioration of the health of particular banking systems—proxied by each creditor banking system simple average of its banks' CDS spreads—was a key variable for explaining the variation of emerging markets' cross-border bank borrowing (measured using Locational BIS data).

Table A3. Determinants of the Change in Borrowers' Foreign Banking Exposures

2006Q2-2012Q1 - Panel OLS with Fixed Effects - Dependent variable: Change in Adjusted Foreign Banking Exposure (in percent)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ΔGDP_{ijt}	0.470** (0.188)					0.284* (0.149)	0.149 (0.139)	0.252* (0.138)	0.284* (0.149)	0.244* (0.140)
Cred_Syst_Crisis		-9.58*** (1.172)				-12.54*** (1.285)	-5.46* (3.159)	-6.09*** (1.713)	-18.74*** (3.306)	
Borrower_CB_Share			-0.250*** (0.071)			-0.311*** (0.066)	-0.310*** (0.063)	-0.289*** (0.066)	-0.268*** (0.096)	-0.290*** (0.065)
Borrower_DLR				5.479 (4.499)		1.569 (4.653)	0.645 (4.667)	0.683 (4.509)		1.761 (4.346)
TED Spread					-0.0126** (0.0055)	-0.0315*** (0.0060)	0.3222 (0.7527)			-0.0655*** (0.0168)
TED * Cred_Syst_Crisis									-0.111*** (0.025)	-0.106*** (0.026)
TED * Borrower_CB_Share									-0.00029* (0.00016)	
TED * Borrower_DLR									0.0183* (0.0097)	0.0368** (0.0174)
Borrower_DLR * Cred_Syst_Crisis									6.593* (3.727)	1.739 (1.747)
Borrower_DLR * Borrower_CB_Share									-0.056 (0.083)	
Cred_Syst_Crisis * Borrower_CB_Share										-0.153*** (0.035)
Quarterly Dummies	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	No	No	Yes	No	No	No
Borrower Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,458	2,458	2,458	2,458	2,458	2,458	2,458	2,458	2,458	2,458
Number of borrower countries	112	112	112	112	112	112	112	112	112	112
R2	0.057	0.078	0.065	0.055	0.055	0.107	0.154	0.116	0.112	0.118

Note: This table reports the baseline panel fixed effect described in Cerutti (2013). Robust standard errors are in parentheses and they are clustered at the borrower country level. Asterisks denote significant of coefficients, with ***, **, * indicating significance at 1%, 5% and 10% level, respectively.

Second, how a country borrows was also important. The results indicate that the larger was the share of cross-border on total borrower foreign claims, the further the decline in borrowers' exposures. This is consistent with Herrero and Martinez Peria (2007) that finds that foreign claim volatility is lower in countries with a larger share of local claims. Even though there was no evidence in the analysis of banks' foreign credit exposures that composition of exposures matters in explaining its evolution, it seems to matter from a borrowing countries' perspective. This divergence between creditors and borrowers analyses could be driven by the fact that the sale/acquisition of a foreign affiliate can have a different impact on them. In the case of borrowers' foreign exposures, in several cases, the affiliate lending (non-funded with local deposits) did not change (much) from the borrowing country perspective, since the acquisition of the foreign affiliate only changed the name of creditor banking system. This was not the case with cross-border borrowing where a creditor banking system reduction in its exposures did not necessarily imply substitution from another

creditor banking system.⁶ With respect to interacted channels, the interaction term with the share of cross-border and TED spread was also statistically significant, showing that the deterioration in borrowers' foreign banking exposures during the peak of the crisis was even higher in the presence of larger direct cross-border. Similarly, the interaction term with the share of cross-border and Cred_Syst_Crisis (column 10) was also statistically significant and negative, highlighting that the presence of systemic bank crisis in creditor countries increased the negative effect of large direct cross-border share in foreign banking exposures.

Third, international financial conditions were also a key driver during the period. This is consistent with findings in the literature measuring the determinants of foreign lending (e.g. World Bank 2008, McGuire and Tarashev 2008, and Kamil and Rai 2010). In the baseline specification (column 6 in Table A3), a one standard deviation increase in TED spreads reduced foreign banking exposures by 1¾ percentage points. As described before, interacted with other borrower countries variables, it increased their negative impact in the evolution of foreign banking exposures.

Finally, not all was driven by external factors. Although only significant at a 10 percent significance level in a few specifications, as expected, the coefficient of GDP growth in borrowing countries was positive. In the sample, a one percent increase in GDP growth increase foreign banking exposures by up to 1/3 of a percent.

Allowing Different Coefficient Slopes for Sweden

As before, in order to explore the possibility that the coefficients for Sweden could be different than the estimated for all countries, an interacted variable capturing each explanatory variable and a dummy for Sweden were introduced in Table A4 below.

In general, the interaction of the global financial variables with the Sweden dummy, indicate that global financial condition had an even larger impact (3 times larger) on the evolution of Swedish borrowers' foreign credit exposure than for the average borrower included in the panel regressions. The evidence for the other factors is more mixed, but shows that several channels have been as important as for other borrowers. From whom countries borrowed (e.g., systemic banking crisis in creditor banking systems translated into a decline in borrowers' foreign banking exposures) and how they borrowed (rollover of direct cross-border lending was much more difficult than of affiliates' lending) would still be significant for Sweden. Instead, the coefficient for Swedish GDP—adding up the coefficient of GDP alone plus the interacted with Sweden dummy—would be slightly lower than for the average borrower when borrower GDP growth is considered alone but even negative with other control variables included. A similar reversal also happens when considering the borrower deposit funding. This is driven by the high dependence of Sweden on wholesale funding.

⁶ The fact that Borrower_CB_Share is still significant at 1 percent level after the inclusion of time dummies (see column 7) indicates that the divergence between creditor and borrower analyses with regard to the composition of exposures are not driven by different time effects.

Table A4. Determinants of the Change in Borrowers' Foreign Banking Exposures

2006Q2-2012Q1 - Panel OLS with Fixed Effects - Dependent variable: Change in Adjusted Foreign Banking Exposure (in percent)						
	(1)	(2)	(3)	(4)	(5)	(6)
ΔGDP_{ijt}	0.470** (0.188)					0.284* (0.149)
$\Delta GDP_{ijt} * SWE$	-0.033 (0.187)					-1.937*** (0.164)
Cred_Syst_Crisis		-9.66*** (1.186)				-12.58*** (1.303)
Cred_Syst_Crisis * SWE		5.39*** (1.175)				-0.23 (1.309)
Borrower_CB_Share			-0.251*** (0.071)			-0.311*** (0.066)
Borrower_CB_Share * SWE			0.658*** (0.069)			0.026 (0.086)
Borrower_DLR				5.492 (4.500)		1.562 (4.658)
Borrower_DLR * SWE				-207.0** (13.63)		-93.976*** (13.83)
TED Spread					-0.0123** (0.0055)	-0.0311*** (0.0060)
TED Spread * SWE					-0.0339*** (0.0058)	-0.0771*** (0.0065)
Quarterly Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	No	No
Borrower Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,458	2,458	2,458	2,458	2,458	2,458
Number of borrower countries	112	112	112	112	112	112
R2	0.057	0.078	0.065	0.055	0.055	0.107

Note: This table reports slightly modified version of the baseline panel fixed effect estimated by Cerutti (2013) due to the use of interacted terms to allow different slopes for Sweden. Robust standard errors are in parentheses and they are clustered at the borrower country level. Asterisks denote significant of coefficients, with ***, **, * indicating significance at 1%, 5% and 10% level, respectively.