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I. POTENTIAL OUTPUT AND UNEMPLOYMENT[1]

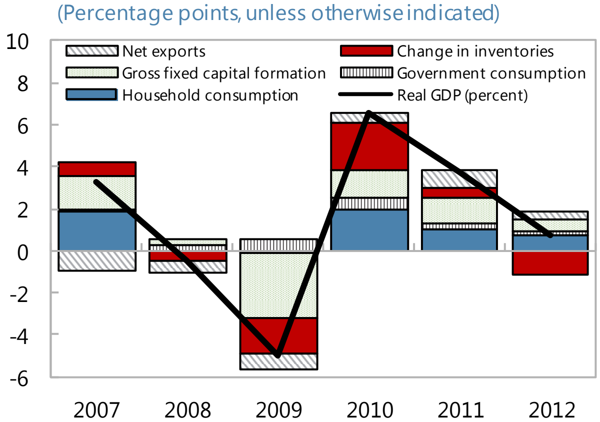
Sweden has suffered a permanent output loss from the crisis and potential output growth will likely moderate going forward relative to pre-crisis rates. At the same time, the natural rate of unemployment has increased and is set to decline only gradually over the medium term.

A. The Great Recession in Sweden

1. **Sweden was hit strongly after the global financial crisis of 2008–09, and growth has moderated after its initial bounce back.** After a contraction of 5 percent in 2009, Swedish growth rebounded to above 3½ percent in 2010 and 2011 before slowing down together with European and global trade (see Figure 1). Meanwhile, the unemployment rate increased to 8 percent by 2012 (see Figure 2).[2] The manufacturing sector, already on a downward trend, was also hard-hit, with a close to 10 percent decline in employment in 2009.

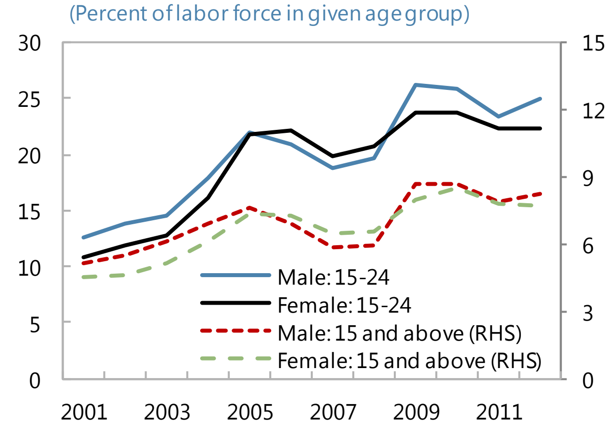
2. **Against this background, this paper assesses the effects of the crisis on potential output.** In 2012, output was 10 percent below the level that would have been reached had output continued to grow at the average 2000–07 growth rate of 3¼ percent. Under current projections, the output loss relative to the 2007 trend continues to widen over the forecast horizon, implying a permanent output loss (see Figure 3).

Figure 1. Contribution to Real GDP Growth
(Percentage points, unless otherwise indicated)



Sources: Haver Analytics and Statistics Sweden.

Figure 2. Unemployment Rate
(Percent of labor force in given age group)



Sources: Eurostat, Haver Analytics, and Fund staff

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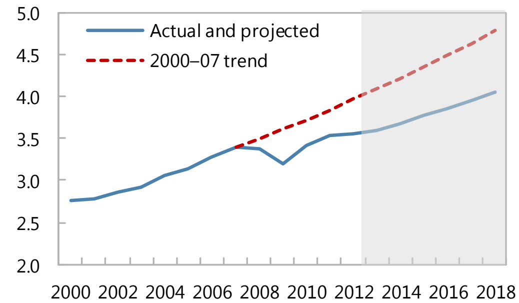
[1] Prepared by Lone Christiansen (EUR).

[2] The level reflects, among other things, the classification of some full-time students as unemployed, accounting for about 2 percentage points of overall unemployment.

3. Simply extending the pre-crisis trend might not be a good indicator of Sweden's growth potential. Table 1 shows estimates from the Swedish Ministry of Finance, the Riksbank, the National Institute of Economic Research (NIER), the European Commission, and Fund staff as reflected in the World Economic Outlook, implying output gaps between -3½ and -1 percent of potential output in 2013. The wide range of estimates indicates the uncertainty of the underlying estimates and suggests a closer look at the differences behind them. In what follows, we estimate potential output in several different ways to inform the discussion about the current cyclical stance of the Swedish economy and longer-term effects on potential growth.

Figure 3. Real GDP
(Bilions of chained Kronor)



Sources: Statistics Sweden, World Economic Outlook database, and Fund staff calculations.

Table 1. Output Gap Estimates
(Percent of potential output)

	2010	2011	2012	2013	2014
European Commission	-1.6	-0.1	-1.3	-1.6	-1.1
Ministry of Finance	-3.1	-1.3	-2.2	-3.5	-3.3
National Institute of Economic Research	-3.6	-1.5	-1.9	-2.1	-1.7
Riksbank 1/	-2.8	-0.5	-0.9	-1.3	-0.6
Fund staff 2/	-1.0	0.8	-0.4	-1.0	-0.7

Sources: Ameco database (June 2013), National Institute of Economic Research (June 2013b), Riksbank (April 2013), Swedish Ministry of Finance (April 2013), World Economic Outlook (July 2013).
1/ Average of quarterly estimates. 2/ World Economic Outlook.

B. Potential Output

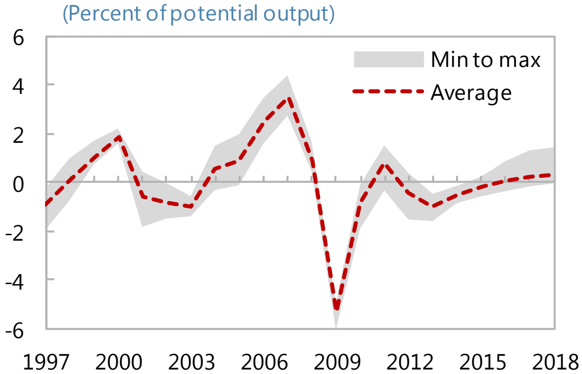
4. Three standard methods to estimate potential output are deployed to identify general trends while avoiding a false sense of precision: a simple HP filter, a production function, and a multivariate approach as in Benes at al. (2010) (see the Appendix for details). For the univariate HP filter, the smoothing parameter is varied to cover ranges suggested in the literature.[3] For the production function approach, potential levels of total factor productivity and the unemployment rate are determined by the HP filter, again obtained from a range of smoothing parameters, and combined with the actual levels of the labor force and the capital stock. To alleviate the end-point problem from the HP-filter, forecasts are extended until 2025. The multivariate filter builds on a

[3] Many authors suggest using a smoothing parameter of 100 (high smoothing) for annual data, while Ravn and Uhlig (2002) suggest a parameter of 6.25 (low smoothing), which will allow for more fluctuations in the filtered series.

macroeconomic model, which jointly determines potential output and the natural rate of unemployment. Note that output forecasts are determined within the model and, hence, may differ from desk projections.

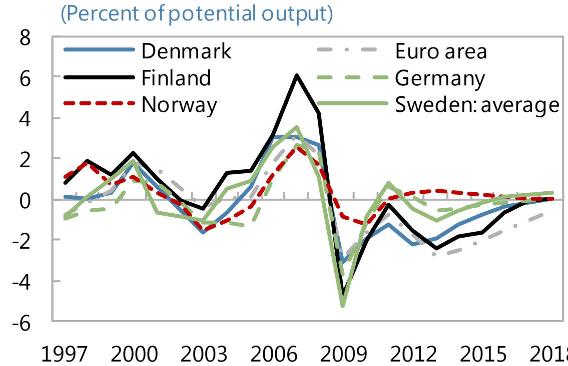
5. Results point to a slightly negative output gap in 2013 after widening from 2012. Based on the range of output gap estimates in 2012, output was likely close to potential. However, as growth is projected to remain weak in 2013, the output gap is projected to widen, with all methods pointing to a negative output gap in the range of -1.6 (multivariate filter) to -0.5 (HP filter and production function with low smoothing) percent of potential output (see Figure 4). The average measure stands at a negative gap of 1 percent, broadly in line with developments in a number of peer economies. For example, Germany's output gap is projected to widen to around -½ percent of potential output (see Figure 5).

Figure 4. Output Gap Estimates
(Percent of potential output)



Sources: Statistics Sweden and Fund staff calculations.

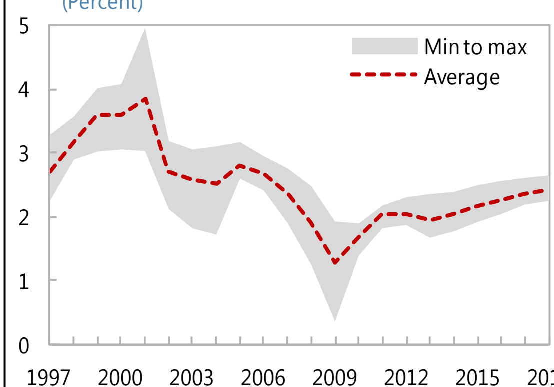
Figure 5. Output Gap
(Percent of potential output)



Sources: World Economic Outlook database and Fund staff calculations.

6. Potential output growth is currently below pre-crisis rates. The various approaches point to 2012 potential growth ranging from just below 2 to 2¼ percent, relative to 2000–07 average potential growth of close to 3 percent (based on the average estimate) (see Figure 6). A decomposition of potential growth using the production function approach suggests that variations in employment and total factor productivity[4] are important contributing factors to the current slowdown as their contributions to growth declined from 0.7 and 0.2 percentage points in 2005 to 0.5 and -0.1 percentage points, respectively, in 2012 (see Figure 7).

Figure 6. Potential Growth Estimates
(Percent)

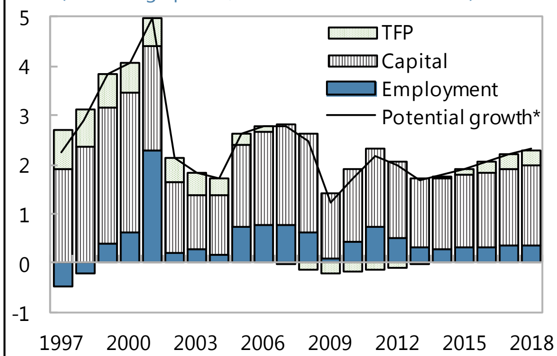


Sources: Statistics Sweden and Fund staff calculations.

[4] Total factor productivity is determined as the residual in a Cobb-Douglas production function with real GDP, labor, and the capital stock.

7. Over the medium term, the output gap is set to close while potential growth will remain somewhat muted. Results suggest the output gap will close in two to five years, depending on the model. However, all approaches suggest a decline in potential growth over the medium term relative to the pre-crisis 2000–07 average, with the average measure pointing to a ½ percentage point decline. The production function points to a slowdown in potential growth from an average of close to 3 percent during 2000–07 to just above 2 percent in the medium term as the contribution to growth from employment remains subdued over the forecast horizon (see below for further analysis of the structural rate of unemployment).

Figure 7. Contributions to Potential Growth
(Percentage points, unless otherwise indicated)



Sources: OECD, Statistics Sweden, and Fund staff calculations. *In percent.

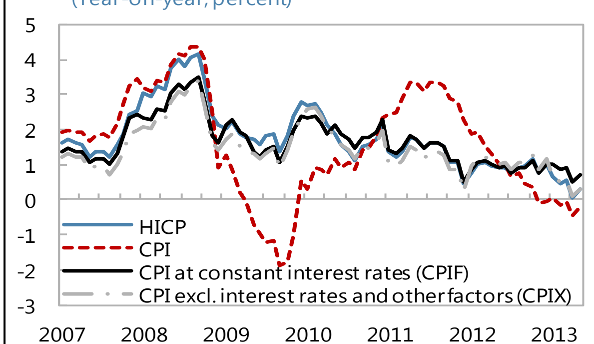
C. The Natural Rate of Unemployment

8. Headline inflation and the output gap provide seemingly conflicting views on the level of the underlying, equilibrium, rate of unemployment. Year-on-year consumer price (CPI) inflation below zero seems to suggest the economy is operating well below potential capacity and, hence, that a substantial share of the elevated unemployment rate is explained by cyclical factors. In contrast, a small output gap, estimated at around -1 percent of potential GDP in 2013, suggests a large part of the actual level of unemployment is structural in nature. This is consistent with the NIER's (2013a) estimate of an equilibrium level of unemployment at just below 7 percent for 2013, gradually decreasing to 6.5 percent in 2017 as previously implemented reforms will have effect.

Explaining the Low Rate of Inflation

9. However, the low rate of inflation is driven mostly by exchange rate and interest rate developments. While there is some slack in the economy with a moderating impact on price developments, the direct effects of low interest rates (in particular, mortgage rates, which play a significant role for household spending in Sweden) and low imported inflation are the main factors in explaining current year-on-year deflation in consumer prices.

Figure 8. Inflation
(Year-on-year, percent)

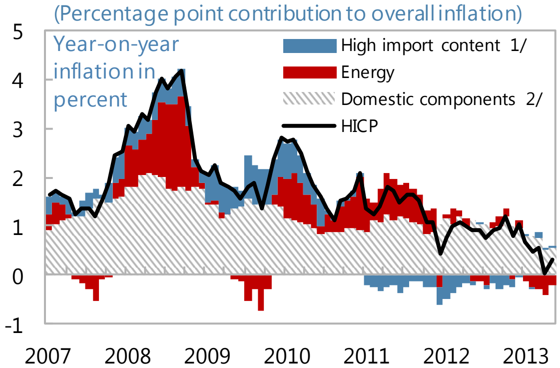


Sources: Haver Analytics, Eurostat, Statistics Sweden, and Fund staff calculations.

- **Low interest rates directly impact Swedish consumer price inflation.** While the Harmonized Index of Consumer Prices (HICP) excludes certain interest costs, these are included in the Swedish Consumer Price Index (CPI),[5] which the Riksbank is monitoring against its 2 percent inflation target. Hence, current low interest rates have contributed to substantial movements in the CPI (see Figure 8). To support monetary policy decision making, Statistics Sweden also computes two underlying consumer price indices: the CPIF, which captures the CPI at fixed interest rates, and the CPIX, which modifies the CPI to exclude all interest costs for owner-occupied dwellings.[6] The CPIF and the HICP rates of inflation evolve similarly, underlining the importance of the effect of interest rate changes.

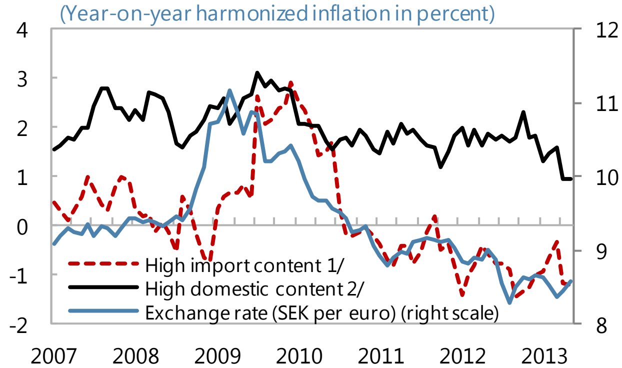
- **Low imported inflation is another key factor in explaining the low rate of inflation.** Figure 9 shows a decomposition of HICP inflation, while Figure 10 shows the rate of inflation in components with high import content and high domestic content. Inflation in services, a mainly domestic component, has been relatively constant at just below 2 percent over the last few years, only declining recently. Conversely, non-energy industrial goods, which traditionally have high import content, have experienced deflation, contributing to lower inflation.

Figure 9. Harmonized Consumer Price Inflation
(Percentage point contribution to overall inflation)



Sources: Eurostat, Haver Analytics, and Fund staff calculations.
1/ Non-energy industrial goods and unprocessed food.
2/ Processed food, alcohol, tobacco, and services.

Figure 10. Inflation and the Exchange Rate
(Year-on-year harmonized inflation in percent)



Sources: Eurostat, Haver Analytics, Statistics Sweden, and Fund staff calculations. 1/ Non-energy industrial goods inflation. 2/ Services inflation.

Estimating the Natural Rate of Unemployment

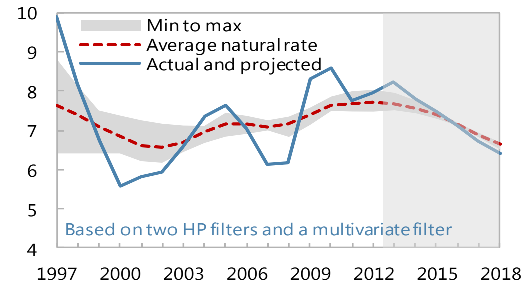
10. Mirroring the results on potential output, there are indications that the natural rate of unemployment is elevated. Based on the multivariate filter approach, which computes an estimate of the natural rate of unemployment along with potential growth, the natural rate of unemployment started to increase from the early 2000s (see Figure 11). Along with a predicted improvement in potential growth, likely reflecting past labor market reforms, the model suggests that the natural

[5] In particular, interest costs for owner-occupied housing and certain costs of owner-occupied homes such as repairs, real-estate taxes, write-offs and insurance, as well as fees for tenant-owned flats are excluded from the HICP but are included in the CPI.

[6] The interest cost in the CPI is composed of two parts: one index for interest rates and one index for house prices. The effect of the former is removed in the CPIF, while both parts are removed in the CPIX as well as the effects of changes in indirect taxes and subsidies.

rate will begin to decline over the forecast horizon. However, with potential growth remaining moderately below pre-crisis rates, the natural rate of unemployment is projected to remain elevated at around 6½ percent over the medium term, a result also confirmed from HP-filter approaches.[7]

Figure 11. Unemployment
(Percent)



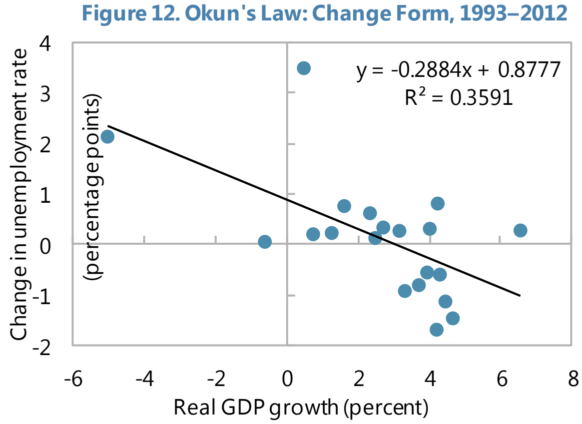
Sources: Statistics Sweden, World Economic Outlook database, and Fund staff calculations.

11. Okun's law can be used to generate an alternative estimate of the natural rate of unemployment. Okun (1962) estimated a relationship between real GDP and unemployment, which can be expressed in two forms: the gap form and the change form. The gap form expresses a linear negative relationship between the output gap, Y^{gap}, and the excess unemployment, u, over the natural rate, $\bar{u}$, during 1993–2012. The change form relates the growth rate in GDP, $\frac{\Delta Y}{Y}$, to percentage point changes in the unemployment rate, Δu. Equations (1) and (2) show both forms, where c and k are parameters. k indicates the average growth rate of potential output, and the intercept in a regression of the unemployment rate on the output gap can be interpreted as the (time-invariant) natural rate of unemployment.

(1) $Y^{gap} = -c(u-\bar{u})$ or $u = \bar{u} - \frac{1}{c}Y^{gap}$

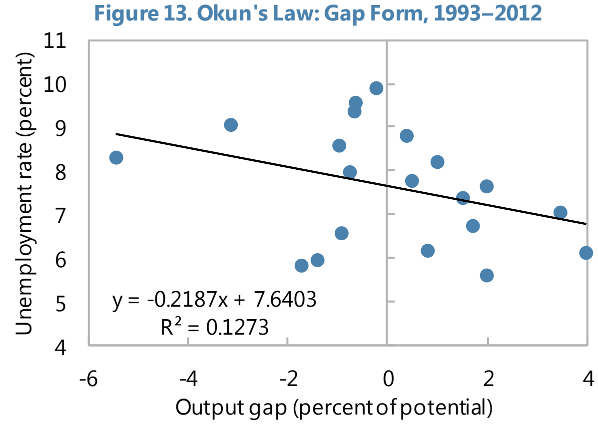
(2) $\frac{\Delta Y}{Y} = k - c\Delta u$ or $\Delta u = d - \frac{1}{c}\frac{\Delta Y}{Y}$

Figure 12. Okun's Law: Change Form, 1993–2012



Sources: Statistics Sweden and Fund staff calculations.

Figure 13. Okun's Law: Gap Form, 1993–2012



Sources: Statistics Sweden and Fund staff calculations.

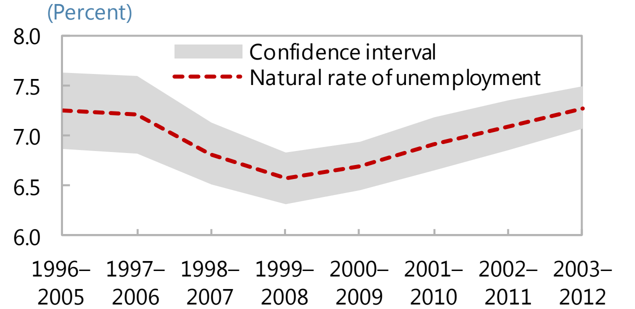
12. The results suggest a natural rate of unemployment above 7 percent. The linear relationship provides an estimate of the parameter c of around 4, meaning that a 1 percentage point increase in the unemployment rate above the natural rate (or a 1 percentage point increase in the actual rate) is associated with output, which is 4 percent below potential (or output growth, which is

[7] The multivariate filter was also run using services inflation in order to capture domestic inflation. This did not materially alter the results.

4 percentage points lower). In addition, from the gap form,[8] we find a natural rate of unemployment of about 7½ percent on average over the sample (see Figures 12 and 13)—similar to the smallest value for 2012 that the filtering methods provided but above the low rates of the early 2000s. However, any linear relationship among these variables likely changes over time, as is also visible from the HP-filter and the multivariate approach—both projecting a declining natural rate of unemployment. In addition, the ¾ percentage point decline in the unemployment rate in 2011 was somewhat larger than that suggested by Okun's law.

13. Rolling regressions of Okun's law illustrate the time variation in the natural rate of unemployment. We use quarterly data during 1996–2012, including quarterly output gap estimates from the multivariate filter approach, to run regressions of equation (1) (the gap form) over varying time periods with the actual unemployment rate as the left-hand-side variable. The results confirm the increase in the natural rate of unemployment in the second half of the 2000s, with the most recent period pointing to a natural rate of just above 7 percent (see Figure 14).

Figure 14. Okun's Law: Natural Rate of Unemployment 1/
(Percent)



Sources: Eurostat and Fund staff calculations.
1/ Each estimate is based on Okun's Law in gap form over various time horizons. The output gap is from the multivariate filter approach. Data are quarterly.

D. Conclusion

14. With potential growth moderately weaker and the natural rate of unemployment to remain elevated, policies should focus on growth-enhancing reforms, especially in the labor market. While Sweden ranks high in most comparisons of structural indicators, owing to extensive reforms in the 1990s, tackling the still existing areas of weakness could help raise the medium-term growth and employment outlook. For example, lifting labor market frictions and alleviating housing rigidities could help raise growth in the medium to long term.[9]

---

[8] Based on the production function approach (smoothing parameter of 100 for HP-filtered input variables).

[9] See Policy Agenda section of IMF (2013) and OECD (2012, 2013) for further discussion.

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Appendix. Methodology

Production function

The production function approach assumes that output can be described by the following Cobb-Douglas production function:

$$Y_t = A_t {K_t}^{1-\alpha} {L_t}^{\alpha}$$

To estimate potential output, total factor productivity, A_t, is backed out from the equation and HP-filtered. The actual stock of capital is assumed to be equal to the potential value. Labor's share in income, α, is set at 0.55. Potential labor input is determined through an HP-filtered unemployment rate and the actual labor force.

In order to alleviate the end-point bias inherent to the HP filter, the variables are expended with projections until 2025.

Multivariate filter

The multivariate filter is based on the approach in Benes et al. (2010). Their model can be described as follows:

The output gap, $ygap_t$, can be described as a function of actual GDP, Y_t, and potential GDP, $\bar{Y}_t$:

$$ygap_t = 100 \cdot \left(log(Y_t) - log(\bar{Y}_t)\right)$$

The unemployment gap, $ugap_t$, is described as the difference between the natural rate of unemployment, $\bar{U}_t$, and the actual unemployment rate U_t:

$$ugap_t = \bar{U}_t - U_t$$

Similar assumptions are made for the capacity utilization gap, $cgap_t$, computed as the difference between the actual manufacturing capacity utilization rate, C_t, and its equilibrium level, $\bar{C}_t$:

$$cgap_t = \bar{C}_t - C_t.$$

An inflation equation links the output gap with year-on-year core inflation, $\pi 4_t$:

$$\pi 4_t = \pi 4_{t-1} + \beta ygap_t + \Omega(ygap_t - ygap_{t-1}) + \varepsilon_t^{\pi 4}$$

and Okun's law, extended to include a lag effect, relates the unemployment and output gaps:

$$ugap_t = \phi_1 ugap_{t-1} + \phi_2 ygap_t + \varepsilon_t^{ugap}$$

A corresponding equation is assumed for the capacity utilization gap:

$$cgap_t = \kappa_1 cgap_{t-1} + \kappa_2 ygap_t + \varepsilon_t^{cgap}$$

Laws of motions for the equilibrium variables are then assumed, including with transitory and more persistent shocks to the system. First, the NAIRU $\bar{U}_t$ is assumed to be affected by transitory level shocks, $\varepsilon_t^{\bar{U}}$, and more persistent shocks, $G_t^{\bar{U}}$, such that:

$$\bar{U}_t = \bar{U}_{t-1} + G_t^{\bar{U}} - \frac{\omega}{100} ygap_{t-1} - \frac{\lambda}{100}(\bar{U}_{t-1} - U^s) + \varepsilon_t^{\bar{U}}$$

where

$$G_t^{\bar{U}} = (1-\alpha) G_{t-1}^{\bar{U}} + \varepsilon_t^{G^{\bar{U}}}$$

Potential output depends on the trend growth rate of potential GDP and on changes in the NAIRU:

$$\bar{Y}_t = \bar{Y}_{t-1} - \theta(\bar{U}_t - \bar{U}_{t-1}) - (1-\theta)(\bar{U}_{t-1} - \bar{U}_{t-20})/19 + G_t^{\bar{Y}}/4 + \varepsilon_t^{\bar{Y}}$$

where

$$G_t^{\bar{Y}} = \tau G_{ss}^{\bar{Y}} + (1-\tau) G_{t-1}^{\bar{Y}} + \varepsilon_t^{G^{\bar{Y}}}$$

Similarly for capacity utilization:

$$\bar{C}_t = \bar{C}_{t-1} + G_t^{\bar{C}} + \varepsilon_t^{\bar{C}}$$

where

$$G_t^{\bar{C}} = (1-\delta) G_{t-1}^{\bar{C}} + \varepsilon_t^{G^{\bar{C}}}$$

The effect of monetary policy is captured through the output gap, which responds negatively when inflation is running above long-term inflation expectations, or positively otherwise:

$$ygap_t = \rho_1 ygap_{t-1} - \frac{\rho_2}{100}(\pi 4_{t-1} - \pi 4_{t-1}^{LTE}) + \varepsilon_t^{ygap}$$

The long-term inflation expectation is also subject to shocks:

$$\pi 4_t^{LTE} = \pi 4_{t-1}^{LTE} + \varepsilon_t^{\pi 4^{LTE}}$$

The model is then estimated with Bayesian methods such that prior distributions help ensure reasonable parameter values. For example, potential output growth is influenced by the prior that it does not deviate too far from its steady state. Specifically, let ε_t be a measurement error that reflects the prior belief about the volatility of potential output growth around its steady state, $G_{ss}^{\bar{Y}}$. Then

$$4 \cdot (\bar{Y}_t - \bar{Y}_{t-1}) = G_{ss}^{\bar{Y}} + \varepsilon_t$$

In addition to prior distributions of the parameters, the steady state unemployment rate is set at 6 percent, the steady state real GDP growth rate at 2.4 percent (coinciding with the 2018 WEO projection), and labor's share in income is set at 0.55.

II. SWEDEN AND THE GLOBAL BANKING SYSTEM: LINKS AND VULNERABILITIES[1]

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

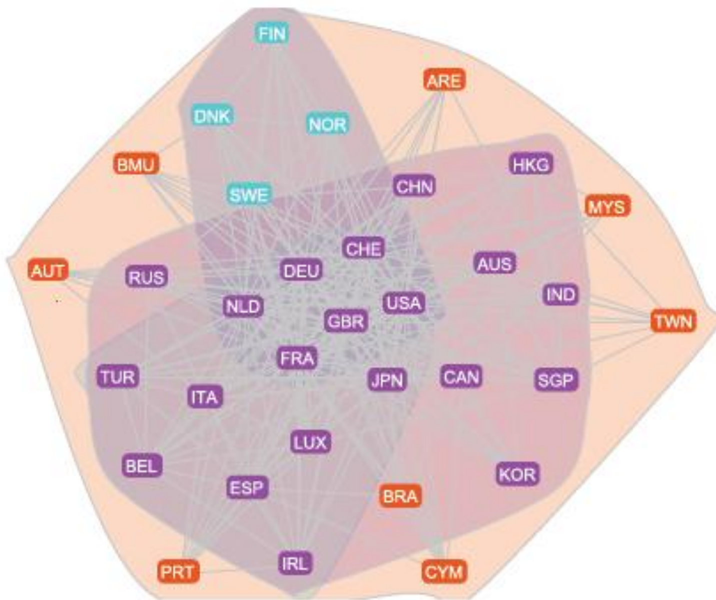
1. Analyzing the role of both Swedish borrowers and creditors within the global banking system is important. The recent financial crises highlighted the role of financial linkages between borrowers and creditors across countries and regions. In this context, this chapter analyzes the nature and intensity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



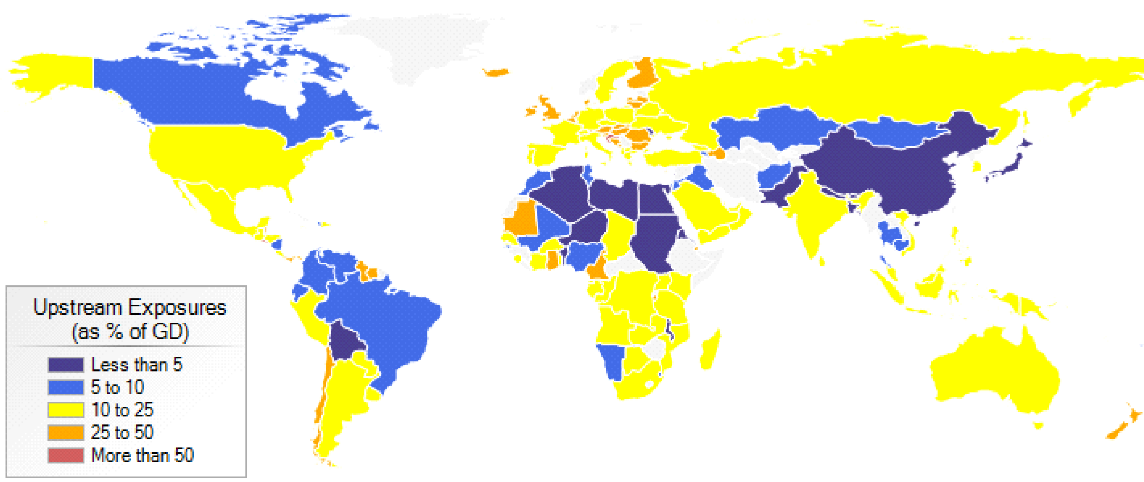
3. **While Swedish borrowers are behind the banking linkages with main global banking centers, Swedish banks' cross-border lending establishes links to the Nordics.** The rest of the chapter presents a detailed analysis of Swedish borrowers' foreign banking exposures and Swedish creditor banks' foreign 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).

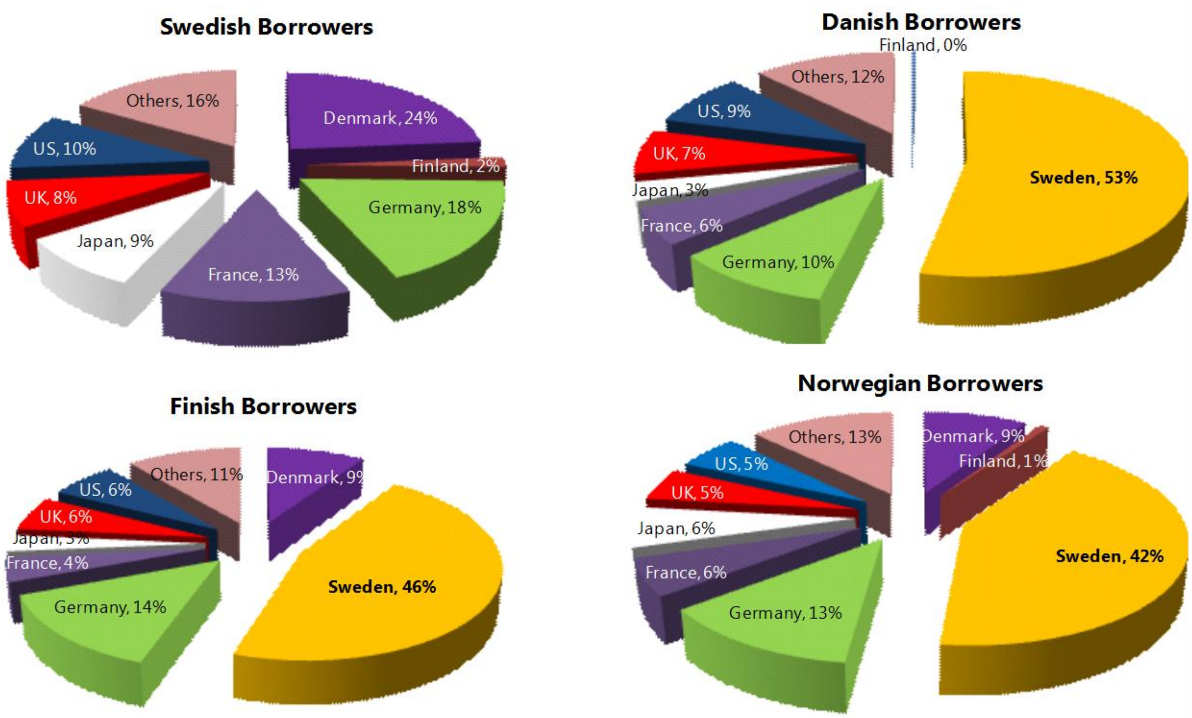
Figure 2. 2012Q2 Borrowers' Foreign Credit Exposures as Percentage of Total Credit



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

6. Swedish foreign borrowing is also more diversified than other Nordic borrowers. Unlike the rest of the Nordic countries, where more than ½ of borrowers' foreign banking exposures are within Nordic banking systems, only ¼ 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).

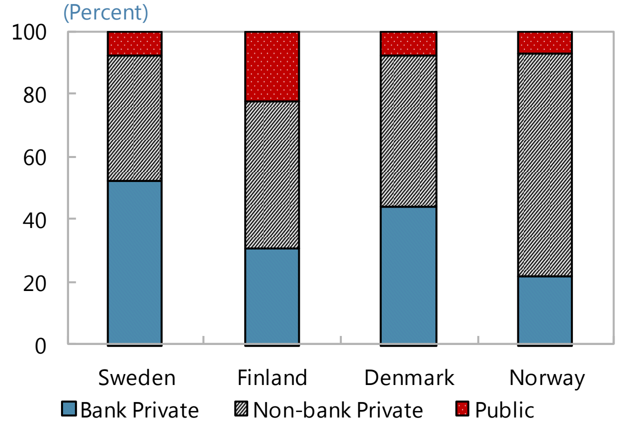
Figure 3. 2012Q2 Nordic Borrowers' Foreign Credit Exposure by Country



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.

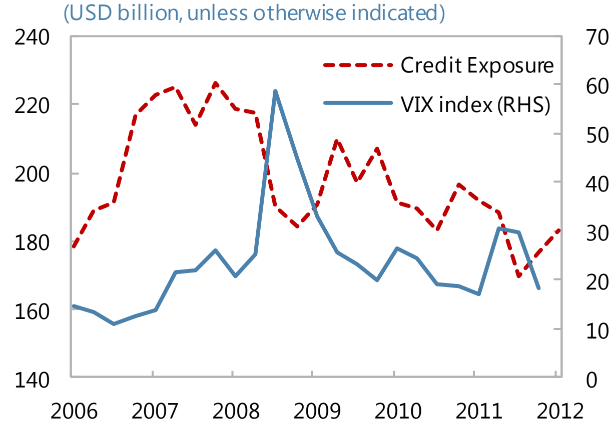
Figure 4. Borrowers' Foreign Credit Exposure by Sector
(Percent)



Sources: BIS and Fund staff calculations.

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).

Figure 5. Swedish Borrowers' Foreign Credit Exposure
(USD billion, unless otherwise indicated)



Sources: BIS, Bloomberg, and Fund staff calculations.

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

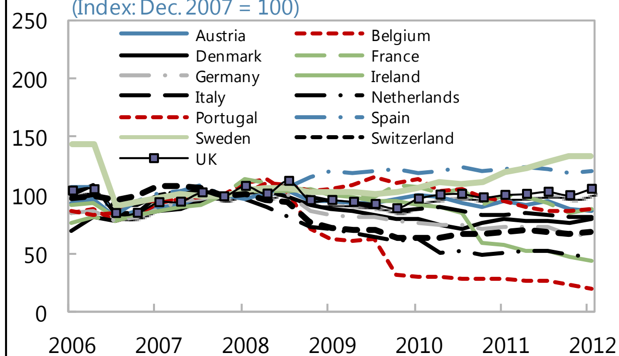
10. As in the previous section, the level of exposures of a banking creditor system to foreign borrowers can be measured by combining BIS data and bank-level data. The level of exposure to borrower countries is often overstated by using simple BIS CBS balance sheet claims, which captures, under the concept 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.

Figure 6. Evolution of European Banks' Foreign Exposures
(Index: Dec. 2007 = 100)



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

[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 inmediate 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.

Figure 7. Bank Losses after Specific Shocks
(Percent of GDP)

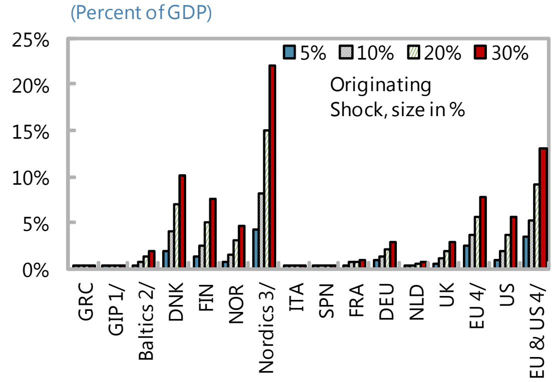
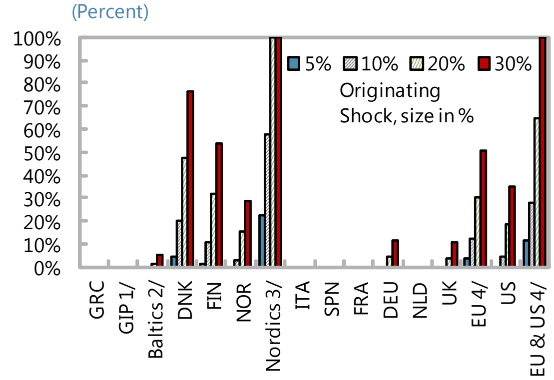


Figure 8. Deleveraging Needs after Specific Shocks
(Percent)



Sources: RES Bank Contagion based on BIS, ECB, and IFS data.
1/ Greece, Ireland, and Portugal. 2/ Estonia, Latvia and Lithuania. 3/ Denmark, Finland, and Norway. 4/ Greece, Ireland, Portugal, Italy, Spain, France, Germany, Netherlands, and UK.

[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 asuming 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.

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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.

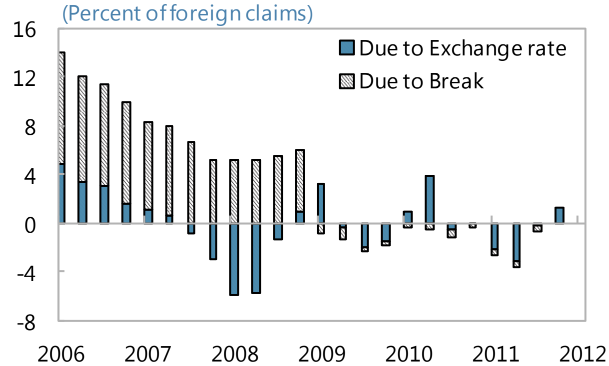
Adjustment for Coverage Break-in-Series

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).

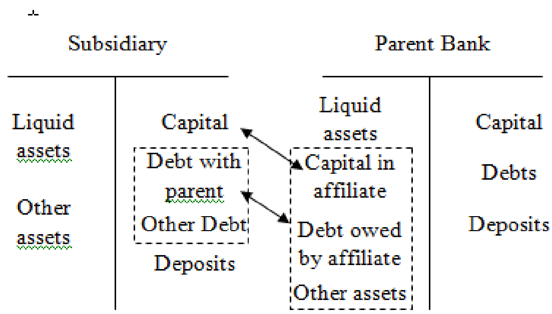
Break-in Series and Exchange Rate Adjustments in Foreign Claims
(Percent of foreign claims)



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: $A_{ij} = Cross\,border\,claims_{ij}$ captures the direct cross-border exposure from creditor country i on debtor country j; $B_{ij} = total\_assets_{ij}^{subs} - deposits_{ij}^{subs} + total\_assets_{ij}^{branch}$ captures the exposure to subsidiaries and branches, taking into account the legal differences between them; $C_{ij} = local\ claims_{ij} - \sum_{subs\&branch} total\_assets_{ij}$ 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 $D_{ij} = derivatives_{ij} + guarantees_{ij} + credit\_commitments_{ij}$ 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 $V_j = \Pr ob\, crisis_j * LGD_j$ 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:

$$Upstream\ Exposure_j = Crossborder\ claims_{ij} + Local\ claims_{ij} * (1 - Min(deposit\ loan\_ratio_{ij}, 1))$$

where: $Crossborder\ claims_{ij}$ 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 $1 - Min(deposit\ loan\_ratio_{ij}, 1)$ 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 total_assets = liquid_assets + other_assets, then
$$B_{ij} LGD_j = \min(other\_assets_{ij}^{sub} * LGD_j, total\_assets_{ij}^{subs} - deposits_{ij}^{subs}) + other\_assets_{ij}^{branch} * LGD_j$$

[3] In the cases were 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 Exposures[1]

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

Table A1. Determinants of the Change in Banks' Foreign Credit Exposures

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**						0.458	-0.998	0.759	0.547
	(0.693)						(0.934)	(1.110)	(0.629)	(0.799)
Cred_Systemic_Crisis		-4.471***					-3.723***	-3.152**	-2.226**	-3.046***
		(0.997)					(1.042)	(1.266)	(0.951)	(0.985)
Cred_DLR			10.99*				8.448	7.386	10.59	7.513
			(5.633)				(5.893)	(5.755)	(7.352)	(6.213)
Cred_CB_Share				0.0465			0.0159	-0.0283	-0.005	0.029
				(0.0697)			(0.0673)	(0.0709)	(0.068)	(0.069)
VIX					-0.104**		-0.0517	0.441		
					(0.0526)		(0.0789)	(0.6513)		
TED Spread						-0.0044	-0.0021	-1.910		
						(0.0073)	(0.0055)	(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	No	Yes	Yes
Time Fixed Effects	No	No	No	No	No	No	No	Yes	No	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

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[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**						0.493
	(0.725)						(0.988)
ΔGDP_{ijt} * SWE	-1.599***						2.156***
	(0.582)						(0.779)
Cred_Systemic_Crisis		-4.471***					-3.723***
		(0.997)					(1.042)
Cred_Systemic_Crisis * SWE 1/		--					--
Cred_DLR			11.02*				8.484
			(5.654)				(5.976)
Cred_DLR * SWE			-81.40***				-422.08***
			(23.61)				(31.17)
Cred_CB_Share				0.0707			0.0382
				(0.0671)			(0.0649)
Cred_CB_Share * SWE				-0.5959			-1.0585
				(0.0681)			(0.0657)
VIX					-.1102**		-0.0588
					(0.0542)		(0.0813)
VIX * SWE					0.171***		0.1959**
					(0.0539)		(0.0821)
TED Spread						-0.0042	-0.0012
						(0.0076)	(0.0056)
TED Spread * SWE						-0.0021	-0.0011
						(0.0081)	(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 Avdjev, 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**					0.284*	0.149	0.252*	0.284*	0.244*
	(0.188)					(0.149)	(0.139)	(0.138)	(0.149)	(0.140)
Cred_Syst_Crisis		-9.58***				-12.54***	-5.46*	-6.09***	-18.74***	
		(1.172)				(1.285)	(3.159)	(1.713)	(3.306)	
Borrower_CB_Share			-0.250***			-0.311***	-0.310***	-0.289***	-0.268***	-0.290***
			(0.071)			(0.066)	(0.063)	(0.066)	(0.096)	(0.065)
Borrower_DLR				5.479		1.569	0.645	0.683		1.761
				(4.499)		(4.653)	(4.667)	(4.509)		(4.346)
TED Spread					-0.0126**	-0.0315***	0.3222		-0.0655***	-0.0030
					(0.0055)	(0.0060)	(0.7527)		(0.0168)	(0.0091)
TED * Cred_Syst_Crisis								-0.111***		-0.106***
								(0.025)		(0.026)
TED * Borrower_CB_Share								-0.00029*		
								(0.00016)		
TED * Borrower_DLR								0.0183*	0.0368**	
								(0.0097)	(0.0174)	
Borrower_DLR * Cred_Syst_Crisis									6.593*	1.739
									(3.727)	(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.

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[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**					0.284*
	(0.188)					(0.149)
ΔGDPijt * SWE	-0.033					-1.937***
	(0.187)					(0.164)
Cred_Syst_Crisis		-9.66***				-12.58***
		(1.186)				(1.303)
Cred_Syst_Crisis * SWE		5.39***				-0.23
		(1.175)				(1.309)
Borrower_CB_Share			-0.251***			-0.311***
			(0.071)			(0.066)
Borrower_CB_Share * SWE			0.658***			0.026
			(0.069)			(0.086)
Borrower_DLR				5.492		1.562
				(4.500)		(4.658)
Borrower_DLR * SWE				-207.0**		-93.976***
				(13.63)		(13.83)
TED Spread					-0.0123**	-0.0311***
					(0.0055)	(0.0060)
TED Spread * SWE					-0.0339***	-0.0771***
					(0.0058)	(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.

III. COVERED BONDS AND FINANCIAL STABILITY[1]

Covered bonds have been increasingly used by Swedish banks since 2006, and the total outstanding amount currently represents more than ½ of Swedish GDP. Their use has enhanced financial stability through several channels (e.g. longer funding maturity, better incentives to bank issuers, and a broader appeal to global investors). However, their extended use could also increase liquidity risks and government contingent liabilities.

A. The Use of Covered Bonds in Sweden

1. **Unlike traditional bonds, covered bonds assure holders a priority claim to specially selected collateral in the so-called cover pool.** A covered bond is a claim on the issuing institution, where if the issuer is not able to meet its obligations, the holder of the bond has priority to specially-selected collateral. Covered bonds differ from traditional mortgage bonds in four main aspects: (i) they are governed by a well-defined regulatory framework that ensures that the cover pool is of high quality (e.g., in Sweden, as detailed in Table 1, this is a function of maximum Loan to Value (LVT) ratios, maximum share of riskier assets, etc.);[2] (ii) the cover pool is dynamic; (iii) the holder of covered bonds has seniority on the cover pool if the issuing institution suspends payments; and (iv) credit risk remains on the balance sheet of the institution that issued the covered bond.

Table 1. Mortgage Loans that can be Included in the Cover Pool
(Percent)

Type of Collateral	Highest Loan-to-Value Ratio	Maximum Share of the Cover Pool
Mortgage loans for housing purposes	75	100
Mortgage loans in property for agricultural purposes	70	100
Mortgage loans in property for commercial purposes	60	10
Public loans to local or central government	100	100
Complementary collateral, such as liquid claims on central and local government	100	20

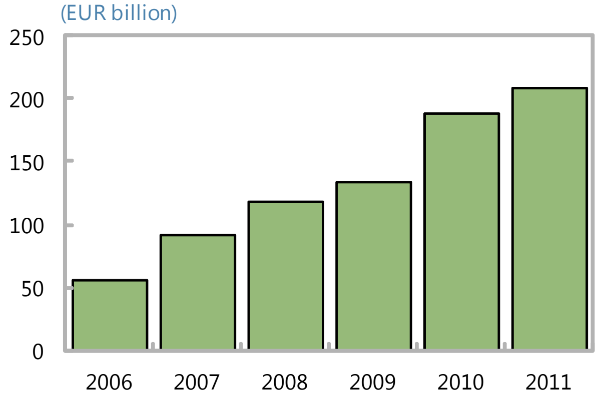
Source: Covered Bonds Issuance Act (2003:1223).

[1] Prepared by Ruchir Agarwal(EUR) and Eugenio Cerutti (RES).

[2] The Swedish rules also require an independent inspector to monitor and ensure that the assets in the cover pool adhere to the requirements. Each cover pool monitor—who is being appointed by the regulator and paid by the covered pool issuer—must submit a report on an annual basis and notify the regulator as soon as he/she learns about an event deemed to be significant.

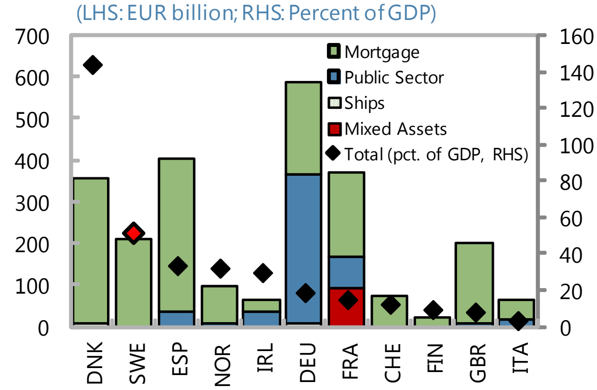
2. Swedish banks started issuing covered bonds in 2006 and they now represent more than ½ of Swedish GDP. The first Swedish covered bonds were issued in 2006 by 3 institutions, and since 2008, 7 approved banks have issued them on the Swedish market. The volume of covered bonds increased rapidly over the years, and they represent more than EUR 200 billion as of 2011 (see Figures 1 and 2). Only Denmark, where covered bonds represent about 150 percent of GDP, has a larger exposure to this type of funding.

Figure 1. Swedish Covered Bond
(EUR billion)



Sources: European Covered Bond Council and Fund staff calculations.

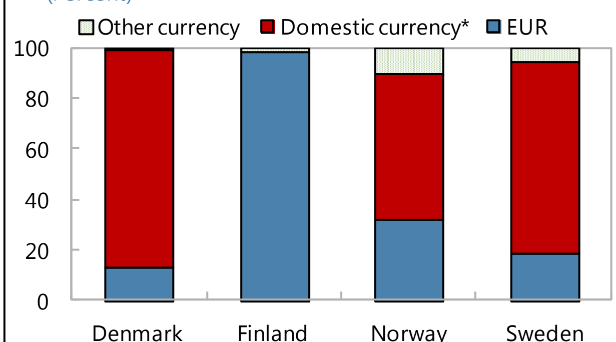
Figure 2. Largest Covered Bond Markets, 2011
(LHS: EUR billion; RHS: Percent of GDP)



Sources: European Covered Bond Council and Fund staff calculations.

3. About one-quarter of covered bonds are issued in foreign currency. To avoid the undesirable effects of exchange rate fluctuations, banks cover the risks associated with lending in Swedish kronor through currency swaps. This avoids liquidity risks in foreign currency but opens the door to rollover risks on these swaps arrangements since they have shorter duration than mortgages.

Figure 3. Currency Composition of Outstanding Covered Bonds
(Percent)



Sources: ECBC and Fund staff calculations
* Covered bonds issued in DKK, SEK and NOK.

B. Implications for Financial Stability

4. The use of covered bonds could increase financial stability through a number of channels:

- **Longer funding duration:** Covered bonds are issued at fixed longer-term periods than traditional bonds (but still below a standard mortgage in Sweden). This improves asset-liability management by adding funding certainty as compared with many other asset backed structures.

- **Larger appeal for bond holders:** The demand of covered bonds is greater than for traditional bonds due to their secured nature and preferential weighting for banks' liquidity requirements (e.g. Basel III allows covered bonds as "Level 2" assets, and they have only 15 percent haircut for the purposes of calculating the Liquidity Coverage Ratio).[3] This higher demand usually translates into lower spread on covered bonds, reducing banks' funding costs. More generally, in distressed markets, covered bonds can also offer a safe alternative to government bonds in conditions when investors demand more safety and there is an overall lack of safe assets.

- **Better incentives for originators:** Issuer and investor interests are better aligned as the issuer retains the credit risk of the assets in the cover pool. Unlike mortgage-backed securities, the bank issuer retains a 100 percent interest in the asset pool of a covered bond, forcing banks to focus on credit quality. Moreover, there are also additional measures to reduce credit risks in the covered bond framework (e.g., incentive for prudent loan origination due to loan-to-value limits, credit risk assessment of the pools, and the external monitoring of loan performance).

5. At the same time, the use of covered bonds could have a negative impact on financial stability:

- **Crowding out of unsecured creditors:** uninsured depositors and other creditors may be less willing to make unsecured loans to banks, which have pledged a large part of the assets as collateral.

- **Concentration risks:** banks could replace third party bonds they hold with mortgage covered bonds issued by other parts of their group (e.g., they own mortgage companies). This could increase risks because banks and their mortgage operations will have increased exposures to the same clients.

- **Increase liquidity risks:** A large portion of low-risk assets being pledged as collateral would decrease banks' future access to liquidity. Uncollateralized assets constitute unused liquidity buffers for banks, which can be used for unexpected liquidity needs such as those from committed credit lines or margin calls related to derivatives.

[3] Also as highlighted by Juks (2012), the Solvency II Directive requires insurance companies to hold less capital if they hold covered bonds as compared to unsecured debt. Central banks, such as the ECB, have typically lower haircuts for covered bonds than for unsecured debt. Covered bonds are usually excluded from write-downs in many resolution frameworks, while unsecured debt is not.

C. Potential Impact of a Sharp Reduction in House Prices

6. A downward correction of house prices would trigger losses on bank lending but they could be absorbed by existing bank buffers. As discussed in the Nordic Regional Report (NRR) 2013 and Riksbank stress tests (see Sveriges Riksbank (2011)), Swedish banks' capital buffers would likely be sufficient to deal with the direct impact of lower house prices on their credit portfolio, assuming that historic parameters remain stable. Mortgage lending in Sweden has historically exhibited both low default rates and low loss–given-default rates due to the loans being contracted mostly for primary residences amidst full recourse from lenders, generous and reliable social benefits, and stable (and up to recent years increasing) housing prices.

7. However, house price corrections could occur simultaneously with large increases in banks' funding costs that could trigger additional losses if these increases cannot be passed through to borrowers. Four channels related to covered bonds are analyzed: (i) Non-linear increases in overcollateralization needs; (ii) higher rollover risks; (iii) increasing risks for unsecured creditors; and (iv) impact of larger contingent liabilities on government funding costs.

Non-linear increases in overcollateralization needs

8. Bank funding costs could be further accelerated by banks' needs to increase overcollateralization when the decline in house prices substantially increase loan-to-value ratios of existing mortgages. The amount of collateral that banks have to find to replenish cover pool overcollateralization levels might increase faster, and at increasing speeds, than the decrease in house prices given the current loan-to-value distribution of mortgages (see Box 1 for more details).

Higher rollover risks

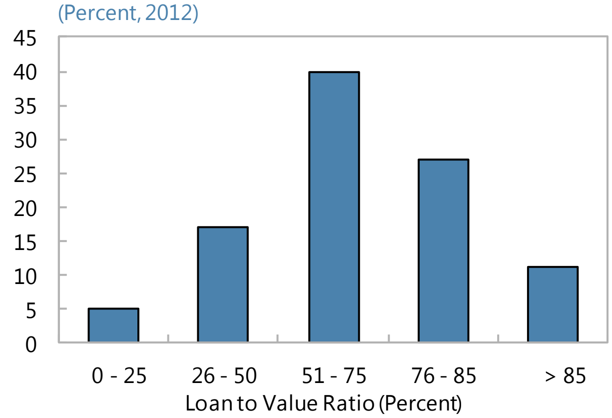
9. A decrease in house prices could affect Swedish banks' capacity to roll over foreign-currency-denominated covered bonds and currency swaps. A sharp fall in house prices could lead investors to start questioning how the liquidity and price of covered bonds may come to be impacted. This type of rollover risk could also extend to currency swaps, which are used to hedge the risks of lending in domestic currency part of the wholesale foreign currency borrowing.

Box 1. How would a drop in House Prices affect Banks' Overcollateralization Needs?

The impact of a reduction in house prices on covered bond markets would depend primarily on the LTV ratios of the loans in the cover pool, the degree of overcollateralization in the cover pool, and the availability of liquidity or substitute collateral to the banks.

To illustrate this effect, we use data on the distribution of LTV ratios from Sweden's Financial Supervisory Authority (FSA). According to the FSA 2013 Report on the Swedish Mortgage Market, the average LTV ratio of banks' mortgage loan portfolio amounts to approximately 64 percent (see Figure), whereas the LTV ratio of new loans is about 70 percent.[1]

Sweden: Mortgage Loans by Loan to Value Ratio
(Percent, 2012)



Source: Sweden FSA.

Taking the midpoint of each LTV category in the 2012 distribution of mortgages, and using the maximum LTV ratio of 75 percent allowed in the collateral pool for household mortgages, it is possible to estimate the change in the number of mortgages fully eligible in the collateral pool. The Table below summarizes these results for price falls of 10, 20, 30, and 40 percent. For example, 38 percent of mortgage loans will not meet the 75 percent threshold for being fully included in the cover pools if house prices fall by 10 percent. Instead, this ratio would increase to 78 percent with a 20 percent house price drop (the midpoint LTV of the 51–75 LTV bucket is now above 75 percent).

Impact of House Price Declines on the Distribution of Mortgage LTV ratios
(Percent)

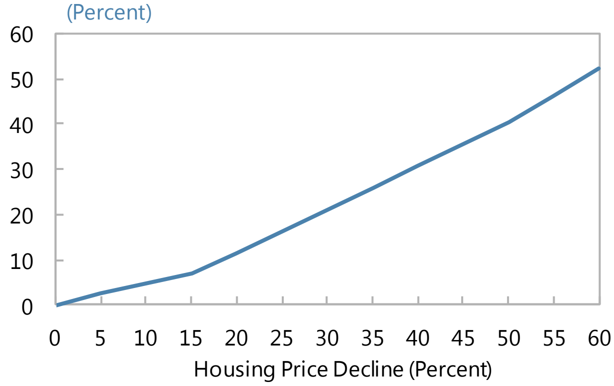
Loan to Value Ratio Category	Distribution	Assume LTV at Midpoint of Category Before Shock	After 10 percent decline in house prices	After 20 percent decline in house prices	After 30 percent decline in house prices	After 40 percent decline in house prices
0 - 25 percent	5	12.5	13.9	15.6	17.9	20.8
26 - 50 percent	17	38	42.2	47.5	54.3	63.3
51 - 75 percent	40	63	70.0	78.8	90.0	105.0
76 - 85 percent	27	80.5	89.4	100.6	115.0	134.2
> 85 percent	11	92.5	102.8	115.6	132.1	154.2
Percentage of Mortgage Loans not meeting 75 percent LTV threshold		38	38	78	78	78
Total	100					

Source: Fund staff calculations

Box 1. How would a drop in House Prices affect Banks' Overcollateralization Needs? (Concluded)

Since a mortgage with a LTV ratio above 75 percent can be included in the cover pool only up to the legal threshold, the reduction in eligible cover pool collateral would be a function of both the magnitude of the decline in house prices and their impact on mortgages' LTVs. Assuming the composition of cover pools is similar to the FSA 2013 distribution of LTV ratios, the adjacent Figure shows the reduction in eligible collateral under different house price declines. The impact of a drop in house prices on the eligible cover pool is non-linear. While a 10 percent reduction in house prices reduces the eligible pool by about 5 percent, a 30 percent drop in house prices triggers a reduction in eligible collateral of about 21 percent. Since many mortgages initially have a below 75 percent LTV ratio, the larger the fall in house prices, the larger the proportion of mortgages that will exceed the maximum limit for LTV. Even though these rough calculations should be taken with caution (e.g. the midpoint of each LTV category is used due to lack of full mortgage distribution data), they highlight the potential impact of the dynamic characteristics of cover pools. If collateral does not fully satisfy the required standards, at least a fraction is removed from the cover pool and has to be replaced or, if not replaced, existing overcollateralization (if any) can be used as a buffer. In this context, if sharp falls in house prices materialize, banks' funding costs could increase due to either the need to replenish cover pools or to the drop in overcollateralization levels—in case they are large enough—triggering rating downgrades in covered bonds (high overcollateralization is often cited by credit rating agencies when giving high ratings, see Bakke et al. (2010)).

Estimated Reduction in Eligible Cover Pool due to Drop in House Prices
(Percent)



Sources: Sweden FSA and Fund staff calculations.

[1] We used the stock of mortgage loans to proxy the aggregate mortgages of Swedish banks' cover pools because an aggregate LTV distribution of the mortgages included in the banks' cover pools is not available with a similar definition. In general, banks' cover pools have a similar average LTV ratio as the total mortgage stock in Sweden. For example, as of 2013Q1, the average LTV ratio for Swedbank is 61 percent, 59 percent for SEB, 55 percent for Nordea, and 47 percent for Handelsbanken.

Increasing risks for unsecured creditors

10. The fall in house prices would shift further risks to unsecured creditors. The risks faced by unsecured creditors, including uninsured depositors, increases with lower house prices since fewer assets will be left for them in the event of a bankruptcy. This is because the dynamic collateralization feature of covered bonds effectively leads to a dynamic subordination of unsecured creditors. This increase in risks could trigger sharp increases in funding costs (or even a sudden stop in unsecured funding flows) especially if the value of implicit government support are perceived to be low.

Impact of larger contingent liabilities on Government funding costs

11. The increase in contingent government liabilities could even drive up sovereign risk premiums if the fall in house prices are very large. Unlike (or to a lower extent than) other unsecured investors, insured depositors do not price in the increased risk at default that may result from large levels of covered bonds and house price declines. The distortion created by the fact that neither depositors nor banks are sensitive to risks could open the door to large costs to the deposit insurance scheme (and the government) in the case of bank failures.[4,5]

D. Conclusion

12. Although covered bonds have many advantages, this form of secured funding could shift risks to unsecured creditors and tax-payers via government contingent liabilities. The level of covered bonds could reach levels where even small declines in house prices could trigger important non-linear effects. Against the background of subordination, several countries have established covered bond issuance limits as percentages of total assets/liabilities (in Canada, Australia, New Zealand, US, among others) or as a function of the capital ratio of each bank (e.g., Italy). In this context, another measure that would incentivize banks to internalize the risks of increasing volumes of covered bonds is to make deposit insurance premiums (charged to banks) a function of the size of collateral pools in bank balance sheets.

[4] The level of deposits in the Swedish banks is about 100 percent of GDP.

[5] Note that this is somewhat limited in Denmark, where large part of the issuers of covered bonds are mortgage institutions that both cannot take deposits and are separate entities without ties to banking groups.

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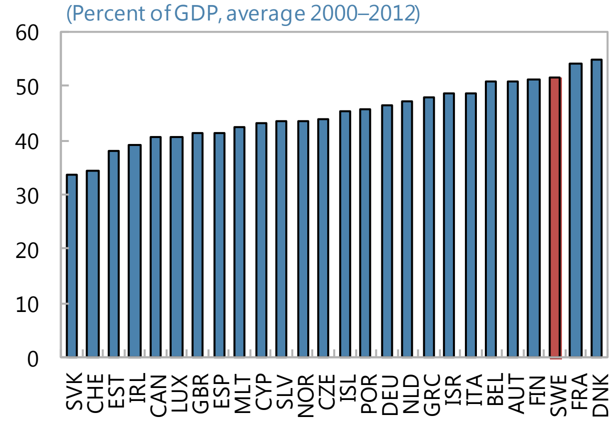
IV. HAS SWEDEN'S FISCAL POLICY BECOME LESS COUNTERCYCLICAL?[1]

Sweden's large public sector and well-developed welfare system are often said to provide large cyclical stabilizers. However, various empirical approaches suggest recent reforms might have reduced the budget's reaction to changes in the output gap.

1. **Sweden's government sector is large, and its social spending is high relative to many other advanced economies.** At around 50 percent of GDP, general government total expenditure ranks among the top of the OECD, second only to spending in Denmark and France (Figure 1).

Figure 1. General Government Total Expenditure
(Percent of GDP, average 2000–2012)

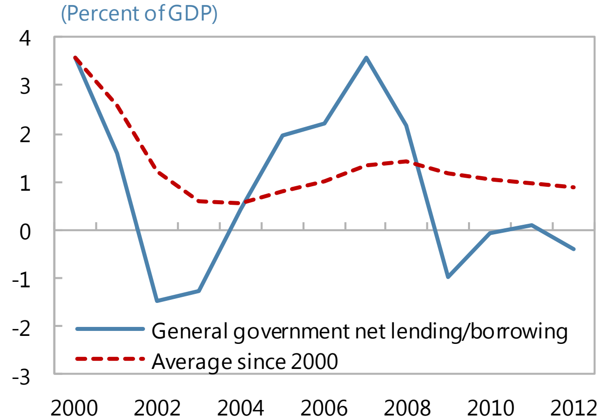


Sources: Haver Analytics and Fund staff calculations.

2. **Within total spending, automatic stabilizers have traditionally been large.** This reflects Sweden's high benefit levels—in particular unemployment benefits—a characteristic of the Nordics' welfare model in which high taxes are used to finance high transfers with the aim of enhancing individual welfare and stabilizing the economy.

3. **However, recent reforms might have reduced the budget's elasticity to changes in economic activity.** Since 2006, the government introduced a series of tax cuts and reduced unemployment and sick leave benefits. These changes come on the heels of a more medium-term consolidation strategy that began in the early 1990s, involving a series of larger cuts and rule changes in income benefits and services. These reforms, together with a strong medium-term fiscal framework, have ensured a general government surplus, averaging above 1 percent since 2006 (Figure 2). When compared to the surplus target rule of 1 percent of GDP over the cycle, the government has mostly met this rule since the fiscal reform took effect in 2000.

Figure 2. General Government Net Lending
(Percent of GDP)



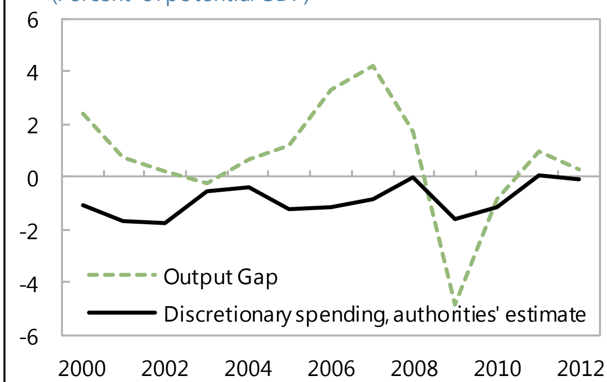
Sources: Sweden Statistics and Fund staff calculations.

[1] Prepared by Ruchir Agarwal (EUR) and Salvatore Dell'Erba (FAD).

4. There is some evidence that the responsiveness of automatic stabilizers to fluctuations in the output gap might indeed have declined. For instance, a study from the National Institute of Economic Research (NIER)—an independent government agency tasked with economic analysis and forecasts—finds that public finances have become less sensitive to fluctuations in the economic cycle, particularly with respect to automatic stabilizers. Measuring automatic stabilizers as the difference between net lending and cyclically adjusted net lending, in percent of potential GDP, they find the elasticity of automatic stabilizers with respect to the output gap has roughly halved over the period 2007–12 compared to the period 1995–2006 (NIER, 2013).

5. At the same time, discretionary spending has become significantly less countercyclical since the recession of 2008. While the formulation of Sweden's surplus balance target rule has not changed since 2000, the way the rule has been implemented has varied over time. For example, the incorporation of larger safety margins in the central government's expenditure ceilings at around the time of the Great Recession could have lowered spending growth during the downturn. Indeed, based on the indicator shown in Figure 3, discretionary spending decreased pro-cyclically just when the output gap opened in 2008–09 before picking up again as the gap started to close thereafter.

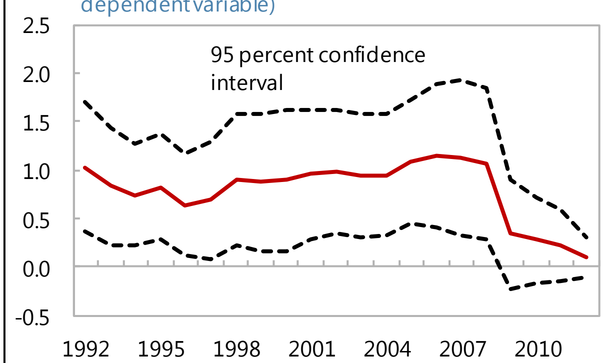
Figure 3. Discretionary Spending in Sweden, 2000–2012
(Percent of potential GDP)



Sources: IMF World Economic Outlook, Sweden Ministry of Finance, and Fund staff calculations.

6. This finding extends to the discretionary budget overall. While the CAPB reacted to changes in the output gap in a countercyclical fashion for much of the 1990s and early 2000s—with the balance improving with the cycle and vice versa—this pattern changed significantly at around the time of the Great Recession (Figure 4).

Figure 4. Response of Cyclically-Adjusted Primary Balance to Changes in Output Gap
(Rolling regression coefficient on output gap; CAPB as dependent variable)



Sources: OECD and Fund staff calculations.

7. Overall, there is evidence that the responsiveness of fiscal policy to the business cycle has declined in recent years. This indicates that there may be room for refinements in the implementation of the fiscal rule. This could include making the use of the generous safety margins incorporated in the expenditure ceiling path contingent on a clear set of rules to limit discretion and, ultimately, a countercyclical use of the discretionary part of the government budget. To reinforce the effectiveness automatic stabilizers, consideration could be given to a targeted re-enforcement of income-support policies to those tenuously attached to the labor force.

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Appendix. Econometric Methodology

This appendix explains the econometric methodology behind the results presented in Figure 4 in the main text. We use the cyclically adjusted primary balance to represents a measure of discretionary fiscal policy, since it measures the primary fiscal balance that would prevail without the impact of automatic fiscal stabilizers.[1] Similarly, the residual—that is, the actual primary balance minus the cyclically-adjusted primary balance—is taken to be a measure of automatic stabilizers. The benefit of this approach is that it allows us to connect the results of this note to the existing academic literature, and it permits us to examine fiscal policy over a much longer horizon (1970–2012).

To understand the reaction of discretionary fiscal policy to the business cycle, we follow Gali and Perotti (2003) and estimate a fiscal rule of the following type:

$$d_t = \alpha + \beta gap_t + \delta debt_{t-1} + \varphi d_{t-1} \tag{1}$$

such that the dependent variable d_t is the cyclically adjusted primary balance as a percentage of potential output; gap_t is the deviation of actual from potential output in percentage of potential output; $debt_{t-1}$ is the gross government debt in percent of GDP; d_{t-1} is the first lag of the dependent variable.

The coefficient of interest is β, which measures the reaction of the discretionary fiscal policy to the business cycle. A value of $\beta > 0$ implies that discretionary fiscal policy tightens during economic expansions while it loosens during slowdowns, thus effectively smoothing income fluctuations. A value of δ>0 indicates that fiscal policy is tighter when the debt-to-GDP ratio is higher, as discussed for example in Bohn (1999) and Wyplosz (2002). To ensure that our estimates are not subject to endogeneity of the business cycle, we rely on instrumental variable estimates (IV) and use as instruments for the variable gap_t its own lag, the output gap of the US, and the average output gap of the three other Nordic countries (Denmark, Norway, and Finland).

Finally, to address the time varying response of fiscal policy to the business cycle and check whether fiscal policy has become more countercyclical over time, in particular following the introduction of the fiscal rule in 1997, we run two types of tests. First, we test for a structural break in the fiscal reaction function (1) by interacting the variable gap_t with an indicator variable equal to one for the period post 1997:

[1] While this methodology is often used for policy analysis, it suffers from limitations. For example, the underlying assumption is that the cyclicality of fiscal revenues and spending items to the cycle is constant over the business cycle, while it could be that the cyclicality is asymmetric during recessions or expansions. Similarly, the methodology does not take into account the effect that asset prices fluctuations (like housing prices) may have on the fiscal budget.

$$d_t = \alpha + FR_t + \beta_1 gap_t + \beta_2 FR_t * gap_t + \delta_1 debt_{t-1} + \delta_1 FR_t * debt_{t-1} + \varphi_1 d_{t-1} + \varphi_2 FR_t * d_{t-1} \quad (2)$$

such that FR_t is the indicator variable equal to one for the post 1997 time period, while the coefficient β_2 now represents reaction of fiscal policy to the business cycle after 1997. A test of $\beta_1 = \beta_2$ will indicate whether a structural break has occurred after 1997. A second test will involve estimating equation (1) over a rolling sample of 20 observations, and check the stability of the coefficients over time.

Results

The estimation results are presented in Tables A1 and A2. In Table A1, Column 1 presents the OLS estimate of equation (1), while Column 2 presents the IV estimates of equation (1). Table A2 contains analogous results for equation (2).

The results in Table A1 show that overall fiscal policy has been countercyclical over the period 1970 to 2012.

However, the results in Table A2 suggest lower countercyclicality in the second part of the sample. In particular, it seems that fiscal policy is acyclical after 1997. To investigate this result further, we estimate a rolling IV regression of specification (1) with a fixed twenty-year window. Based on this exercise, Figure 4 in the main text reports the time-variation of the coefficient on the output gap over time. The first point in the figure is an estimate of the coefficient on the output gap estimated over the period 1973 to 1992. Similarly, the second point is the coefficient estimated over the period 1974 to 1993, and so on.

Table A1. Estimation Results for Model 1

Dependent Variable: CAPB	**OLS**	**IV (using all three Instruments)**
Variables	(1)	(2)
One Period Lagged CAPB	0.76***	0.75***
	(0.12)	(0.11)
Output Gap (percent of potential GDP)	0.32**	0.38**
	(0.15)	(0.18)
Gross Government Debt (percent of GDP)	0.05*	0.06**
	(0.03)	(0.03)
Observations	39	39
R-squared	0.681	0.679
AIC	173.5	173.7
Weak Identification Test		6.608
Test for Over-Identification		3.976

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table A2. Estimation Results for Model 2

Dependent Variable: CAPB	**OLS**	**IV (using all three Instruments)**
Variables	(1)	(2)
Indicator Variable	3.69	4.28
	(3.01)	(2.86)
One Period Lagged CAPB	0.71***	0.67***
	(0.15)	(0.13)
One Period Lagged CAPB X Indicator Variable	-0.48**	-0.45**
	(0.23)	(0.21)
Output Gap (percent of potential GDP)	0.51**	0.71**
	(0.19)	(0.29)
Output Gap X Indicator Variable	-0.44**	-0.62**
	(0.21)	(0.30)
Gross Government Debt (percent of GDP)	0.07**	0.08**
	(0.03)	(0.03)
Gross Government Debt X Indicator Variable	-0.04	-0.05
	(0.06)	(0.05)
Observations	39	39
R-squared	0.715	0.708
AIC	177.0	178.1
Weak Identification Test		4.119
Test for Over-Identification		8.735

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

V. CONTINGENT LIABILITIES FOR THE SWEDISH GOVERNMENT AND OPTIMAL SIZE OF FISCAL BUFFERS[1]

Government contingent liabilities arising from a potential need to support the Swedish banking system could be large, ranging from just below 20 percent of GDP to about 90 percent of GDP depending on the magnitude of the crisis. However, there is considerable uncertainty around such estimates, including from the scope of the potential government intervention, changing reliance on wholesale funding, and potential losses on the balance sheets. A small, stylized model of the Swedish economy suggests that the optimal size of fiscal buffers needed to prepare for such losses is roughly in the range of the contingent liabilities. But the results suggest a gradual build-up to smooth the impact on government spending and GDP.

A. Estimating Government Contingent Liabilities

The Scope of Liabilities—Overview

1. **When one or more banks fail in a country, the central government may have to come to the rescue.** Whether a government is obligated by law or simply forced by circumstances to provide public financing to cover such contingencies, the realization of such contingent liabilities can lead to large increases in public debt. As recent episodes have indicated, the scope of the government bailout of the banking sector may only cover insured depositors, or may additionally extend to uninsured depositors, and even unsecured creditors (as in Ireland in 2008). Such uncertainty about the extent of the government bailout makes estimating the size of contingent liabilities very difficult. In Sweden, a discussion has begun on how to ensure the framework's countercyclicality as well as the absence of an explicit long-term anchor to take into account potentially large contingent liabilities from the financial sector.[2]

2. **To shed light on the scope of liabilities a government might face, this note estimates contingent liabilities of the government under different bailout scenarios.** The methodology—the *balance sheet method*—allows for estimation of government contingent liabilities arising from insured and uninsured deposits.

- This approach assumes that when a bank fails, the assets of the bank are placed in a bankruptcy estate, while the depositors are paid out by the government through the depositor insurance fund.

[1] Prepared by Ruchir Agarwal (EUR).

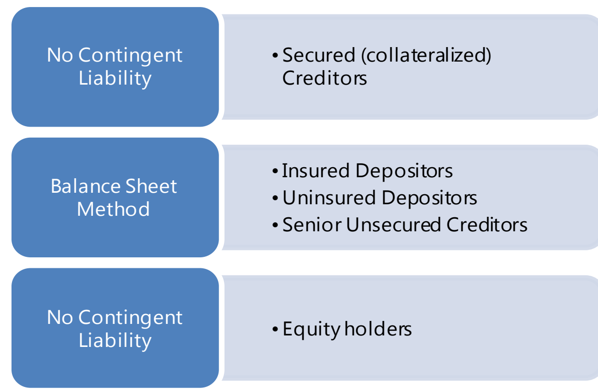
[2] A newly appointed government committee—the Inquiry on Swedish Government Debt Management—is tasked with exploring issues of long-term debt targets.

- The net loss of the government arising from bailing out depositors is then derived by estimating the liquidation value of the bankruptcy estate and taking the priority ranking of the government against the bankruptcy estate. This net loss is taken as the contingent liability of the government from bailing out depositors.

- Three different scenarios with varying degrees of government support are considered: in the first scenario insured depositors are bailed out; in the second scenario, in addition, the uninsured depositors are kept whole; and in the third scenario senior unsecured creditors are also held without loss.

3. **Combining the estimates from different scenarios gives an estimate of the sum of contingent liabilities facing the government from different claimants on bank assets (Figure 1).** The next sections discuss the approach in detail.

Figure 1. Bank Liabilities by Seniority and Methodology for Estimating Government Contingent Liability



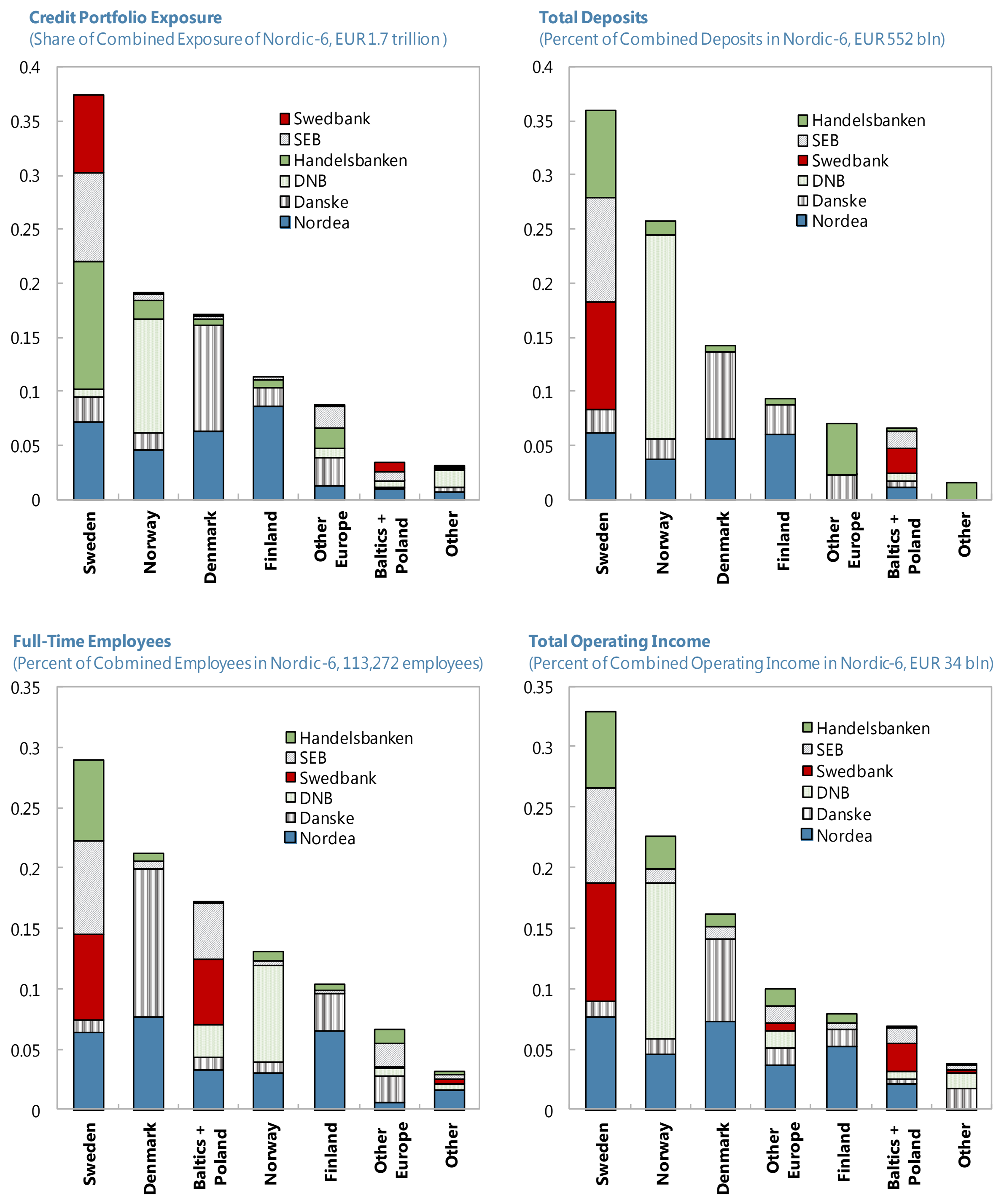
Balance Sheet Method

4. **The analysis focuses on the largest six Nordic banks ("Nordic-6"), four of which are headquartered in Sweden.** Table 1 provides details about the size of these six banks and Figure 2 demonstrates the cross-border operations of these six banks. The second panel of Figure 2 illustrates that some Swedish households and firms deposit money in non-Swedish banks such as Danske Bank, while simultaneously, Swedish banks operate in other countries (mostly Nordic) and accept deposits from non-Swedish households and firms.

Table 1. Largest Nordic Banks (EUR billions, most recent quarter)

Largest Listed Nordic Banks	Incorporated in	Total Assets	Share	GDP in Host Country	Assets/Host GDP
Nordea Bank AB	Sweden	677.4	0.30	410.9	1.6
Danske Bank A/S	Denmark	482.8	0.21	244.2	2.0
DNB ASA	Norway	321.8	0.14	394.7	0.8
Swedbank AB	Sweden	215.0	0.09	410.9	0.5
Skandinaviska Enskilda Banken AB	Sweden	285.7	0.13	410.9	0.7
Svenska Handelsbanken AB	Sweden	297.7	0.13	410.9	0.7
Total		2280.4	1.00		

Figure 2. Exposure of Nordic-6, by Geography 2012



Sources: 2012 Annual Reports and Fund staff calculations.

5. The cross-border nature of banking in the Nordic region implies that any fiscal consequences of government support is highly dependent on the burden sharing rule, which determines how the cost of a bank failure will be shared between the countries involved. To capture this issue, the analysis considers two different burden sharing rules: a *deposit base approach,* determining each country's burden based on the share of depositors residing in the respective countries; and a *location-of-parent approach,* which determines each country's burden based on the headquarter location of each of the Nordic-6 banks.

6. In addition, the analysis varies the treatment of unsecured depositors by considering three bailout scenarios. In Scenario A, all uninsured depositors are bailed in (implying a haircut of 100 percent), whereas in Scenario B the uninsured depositors are also bailed out completely. Lastly, in Scenario C, there is an additional bailout for the senior unsecured creditors of the banks (with all other assumptions being identical to Scenario B). Note that in all three scenarios, the insured depositors are kept whole.

7. To complete the analysis, additional assumptions about the liquidation value of the bankruptcy estate are needed. Table 2 summarizes all relevant assumptions and Table 3 lists the timeline of the analysis.

Table 2. Assumptions and Inputs

Scenario A: Insured Depositors Bailed Out; Uninsured Depositors Bailed In	**Value**	**Notes**
Fraction of deposits that is insured (Sweden, Denmark, Finland)	70%	Deposit Insurance Coverage is €100,000
Fraction of deposits that is insured (Norway)	56%	Deposit Insurance Coverage is approx. €264,000
Fraction eventually recovered by DIF from BE of Synthetic Bank	50%	Relatively high due to senior secured liabilities
Levy on uninsured depositors	100%	By Assumption
Scenario B: Insured Depositors Bailed Out; Uninsured Depositors Levied 20% Haircut	**Value**	**Notes**
Fraction of deposits that is insured (Sweden, Denmark, Finland)	70%	Deposit Insurance Coverage is €100,000
Fraction of deposits that is insured (Norway)	56%	Deposit Insurance Coverage is approx. €264,000
Fraction eventually recovered by DIF from BE of Synthetic Bank 1/	40%	Relatively high due to senior secured liabilities
Levy on uninsured depositors	20%	By assumption

1/ In Scenario B the recovery prospect for the Deposit Insurance Fund is lower since for simplicity it is assumed that the initial payout to uninsured depositors is also serviced by the DIF.

Table 3: Timeline of Scenario Analysis

Time, *t*	Actions
1	All Banks fail
2	Assets put into Bankruptcy Estate (BE)
3	Bailed out depositor claims moved to health bank; financed by DIF/State ("Liquidity Payout")
4	DIF/State is senior-most claimant against the BE (after secured creditors claimed collateral)
5	Payout by BE to DIF/State (Liquidity Payout minus this payment determines "Eventual Payout")

Source: Fund staff calculations.

8. In the event that any one of the six banks fails, it is expected that the insured depositors will be bailed out with certainty due to the explicit coverage by deposit insurance. Therefore, the losses under Scenario A should be interpreted as the lower bound of government contingent liabilities arising from the Nordic-6. That is, the expected loss calculations under Scenario A should be interpreted as the minimum losses to the government arising in a tail event when the banking system as a whole requires a bailout. It is, however, likely that in such an event, the uninsured depositors may also get a partial bailout. Scenario B is constructed to factor such additional liabilities into the calculation of possible losses. Similarly, in order to contain systemic risks the authorities may, in principle, also consider extending the bailout to senior unsecured creditors, and Scenario C considers this case.

9. Table 4 summarizes the result of this analysis. As anticipated, the expected losses—that is, the contingent liabilities stemming from the treatment of depositors—to the Swedish government are very sensitive to the burden sharing rule, whereby the losses vary from 17–60 percent of GDP under a deposit base approach to burden sharing to 26–90 percent of GDP under a country of location-of-parent approach. This is because four out of the six largest Nordic banks are headquartered in Sweden (Nordea Bank, Swedbank, SEB, and Handelsbanken). Correspondingly, if the Swedish government ends up having to bear the losses emanating from the cross-border operations of these banks then the size of contingent liabilities ends up becoming quite large.

Table 4: Estimated Fiscal Costs from the Failure of Big 6 Banks under Different Scenarios

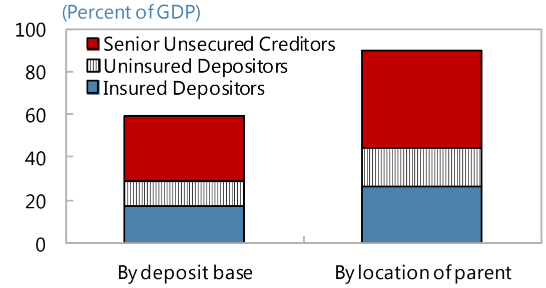
Country	2012 National GDP	Total Assets of Big 6 Banks (consolidated basis)	Estimated Fiscal Costs					
			By Depositor Base			By Location of Parent		
			Scenario A	Scenario B	Scenario C	Scenario A	Scenario B	Scenario C
	(EUR bil.)		*(Percent of GDP)*					
Sweden	**409.2**	**1475.9**	**17.0**	**29.1**	**59.7**	**24.4**	**44.6**	**91.5**
Denmark	245.0	482.8	11.2	19.1	39.2	13.3	24.3	50.0
Finland	194.5	0.0	9.3	15.9	32.6	0.0	0.0	0.0
Norway	390.0	321.8	10.2	21.8	44.7	5.6	10.2	20.9
Nordic-4	**1238.7**	**2280.4**	**12.5**	**22.7**	**46.7**	**12.5**	**22.7**	**46.7**

Source: Fund staff calculations.

Summing Up

10. The balance sheet method suggests that the Swedish government's contingent liabilities arising from the possible need to support the depositors of the six largest Nordic banks range from just below 20 percent of GDP to 90 percent of GDP. This estimate crucially depends on whether the government will bail out the uninsured depositors and the senior unsecured creditors, and also on the burden sharing rule between the Nordic countries (Figure 3).

Figure 3. Potential Fiscal Costs to Sweden of Bailing Out the Six Largest Nordic Banks 1/
(Percent of GDP)



Sources: SNL Financial and Fund staff calculations.
1/ Bailout costs cover different types of creditors and depositors under alternative burden sharing rules across the Nordic countries involved.

11. Taking a mid-range of the contingent liabilities arising from both burden sharing rules suggests overall contingent liabilities amounting to 30–45 percent of GDP. There is considerable uncertainty around such numbers. One reason is that the government's approach to unsecured depositors and bond holders could be different than assumed. For example, the estimate would drop to between 20 and 30 percent were the government only to support insured depositors. Another source of considerable uncertainty is the level of bank losses on the balance sheets, which might be higher or lower than those implied by the end-2012 numbers used in the calculations above. Overall, these estimates are very large relative to the ex-post cost of the 1990s bailout of Swedish banks, estimated at less than 5 percent of GDP. The difference can be explained mostly by the much larger size of the banking system, increased asset encumbrance due to heavy reliance on collateralized debt, and complications for the resolution strategy associated with cross-border operations.

B. Optimal Fiscal Buffer and Speed of Accumulation

12. What kind of fiscal buffer should Sweden consider in light of its large contingent liability arising from the financial sector? While the first response is certainly further progress in strengthening the banks themselves, reducing risks from household credit growth, and improving internal and Nordic macroprudential coordination, it also seems prudent to secure fiscal buffers that allow the government to absorb the fiscal burden should the need arise. In principle, such fiscal buffers can be created, for example, by limiting gross debt levels such that contingent liabilities could be covered by issuing new debt if necessary, or by building up sufficiently liquid reserves in a dedicated fund that is deployed when such contingencies materialize.[3] In what follows, we explore the conceptual issue of how the government should go about building such a buffer if no such buffer existed at the outset.[4]

[3] A potential downside to having a dedicated fund is that it exacerbates potential moral hazard by pre-committing to deploy funds in the event of a banking crisis. On the other hand, a benefit of having a fund is that it allows Sweden to have a sufficiently active and liquid market for sovereign debt by not limiting the size of debt levels.

[4] A different question is whether the existing debt level or funds accumulated in the Swedish Stability Fund do already provide the required buffer.

Setup

13. In order to determine the optimal size of a fiscal buffer given contingent liabilities and the speed of accumulation, we rely on a simple optimization problem of the government (see the Appendix). In the model, the government's sole objective is to smooth government spending subject to its dynamic budget constraint. Each period the government raises a fixed quantity of tax revenue and has to decide on the optimal spending plan. The only source of risk the government faces is that in each period, there is a constant probability of the contingent liability being realized, thereby wiping out a fraction of government wealth (or, equivalently, leading to a spike in the gross debt position of the government). Once the risk is realized, the government faces no further risks.

14. In setting up the model this way, the analysis abstracts from other sources of fiscal risk—such as longevity risk, cyclical fluctuations, etc.—and focuses on the problem of contingent liabilities arising from the financial sector. One interpretation of this approach is that it pertains to the permanent component of the government budget that abstracts from both longer-term trends and cyclical factors.

Results

15. Two key results emerge:

- *The long run fiscal buffer target should approximately match the size of the contingent liability:* In the long run (over several decades) the government should target building a fiscal buffer that is almost as large as the size of the contingent liability.

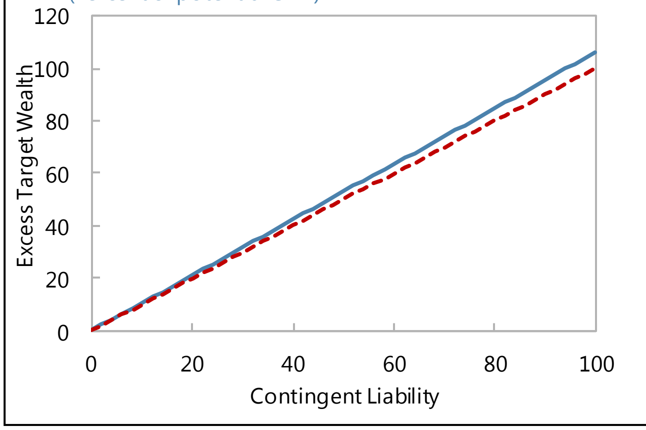
- *The speed of accumulation of the fiscal buffer gradually declines over time:* The model suggests that the government front-loads the accumulation of the buffer, with the speed of accumulation gradually declining over time until the optimal fiscal buffer target is reached.

Size of Target Fiscal Buffer

16. The model's solution suggests that the government's long-run fiscal buffer target is approximately the size of the contingent liability. The intuition stems from the assumption that the government faces a constant probability of a banking sector crisis (i.e., that the contingent liability is being realized in each period): the longer the time horizon, the more likely it is that a crisis will actually occur; ultimately, as the time horizon becomes very long, the crisis probability converges to one. Therefore, from a long run perspective, the contingent liability can be viewed approximately as a real liability, and consequently, the government will find it optimal to create a buffer at least as large as the size of the liability over a period of a few decades.

17. An interesting subtlety of the optimal solution is that it requires the government to slightly 'over-buffer' by creating a target fiscal buffer somewhat larger than the size of the contingent liability (Figure 4). The intuition is that since the government aims at smoothing government spending between periods, it wants to ensure that spending does not increase by a large amount as the contingent liability is realized. Spending in each period depends on the level of debt, since it determines the interest payments the government has to make. This implies that since the government knows that the spending levels will increase after the contingent liabilities are realized due to the increased debt levels, ex-ante they will find it optimal to keep the debt levels low by over-buffering.

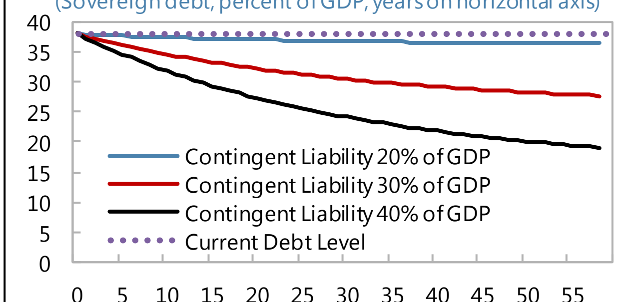
Figure 4. Target Fiscal Buffer as a Function of Contingent Liability
(Percent of potential GDP)



The Optimal Path to Accumulate a Fiscal Buffer

18. How to build the fiscal buffer? The same analytical model used to calculate the size of the buffer also suggests an optimal path for its accumulation along with the implied best time path for government spending. For illustrative purposes, assume that government contingent liabilities amount to 30 percent of GDP. Then for a given set of parameters, the model implies that the target fiscal buffer is roughly 34 percent of GDP. Suppose, in addition, that the government believes that the maximum acceptable level of gross debt is 60 percent of GDP (after the contingent liabilities are realized). Then the model implies that the ex-ante target gross debt level should be around 26 percent of GDP and that this target debt level should be reached gradually. Figure 5 plots the optimal debt path as well as alternative paths for different-sized contingent liabilities.

Figure 5. Model-based Transition Path for Government Debt to Build Optimal Fiscal Buffers against Contingent Liability 1/
(Sovereign debt, percent of GDP; years on horizontal axis)



Source: Fund staff calculations. 1/ Debt threshold, defined as the level of debt the government views as acceptable after the contingent liabilities are realized, is taken to be 60 percent.

19. The figure confirms that, no matter the targeted debt level, building the fiscal buffer should happen over several years. Moreover, the speed of accumulation under the optimal path is high in the first few years, but then tapers off as the size of the fiscal buffer approaches the target fiscal buffer. In the model solution, by front-loading the accumulation, the government ensures that it is at least partially insured if the contingent liabilities materialize immediately.

C. Conclusions

20. This note suggests that the Swedish government could be facing contingent liabilities arising from the financial sector in the range of just below 20 to 90 percent of GDP, with large uncertainties around these estimates. For example, any such number crucially depends on the underlying estimates of bank losses as well as on whether the government decides to bail out unsecured depositors and unsecured bond holders (in addition to insured depositors), and on the burden-sharing rules between countries and the exposure of bank assets to euro area risks.

21. These findings add emphasis to the need for fast progress on financial reforms. Measures to further cool household credit growth and strengthen banks' liquidity and capital positions (see the Policy Agenda section of the 2013 staff report for Sweden) will help to reduce systemic banking risk help limit the size of the contingent liability.

Appendix. Methodology

This model writes down an optimal spending problem of the government when they are faced with a one-time risk of contingent liabilities being realized. This analysis therefore strips away other sources of risks, and focuses on the problem of contingent liabilities arising from the financial sector. Since, other risks arising from longevity, short-term business cycle fluctuations are assumed away, the analysis here should be understood as one pertaining to the permanent (or detrended) component of government spending.

Environment

Consider the problem of a benevolent government that has to choose an expenditure path to maximize household utility. Household's lifetime utility additively depends on private consumption (C_t) and government expenditure (G_t) in each period t, and is given by

$$U_t = E_t \sum_{j=0}^{\infty} \beta^j \left[u\left(C_{t+j}\right) + v\left(G_{t+j}\right) \right] \qquad (0)$$

with the discount factor $\beta \in (0,1)$.

The government faces a deterministic gross rate of return (R), and an exogenous deterministic income stream from taxes (T). Define M_t as resources available to the government (wealth plus current income) at time t, A_t as the end-of-period assets after the government has made its expenditure decisions, and B_t as balance before receipt of current income. Then the budget constraint of the government can be decomposed as:

$$\begin{aligned} A_t &= M_t - G_t \\ B_{t+1} &= RA_t \\ M_{t+1} &= B_{t+1} + T - \xi_{t+1} Z \end{aligned} \qquad (2)$$

Here the only risk arises from a one-time cost arising from an adverse event (for e.g. expenses related to the bailout of the banking sector, natural disaster, etc.). Therefore, $Z > 0$ is the contingent liability of the government, and ξ_{t+1} is a dummy variable indicating whether the liability is realized for the government in period t.

The government faces a constant risk ϕ of the shock realizing. That is, in each period $\xi_t = 1$ with probability ϕ, and $\xi_t = 0$ with probability $1-\phi$. In this setup, the liability is a one-time only risk, and therefore once the risk is realized there is no chance of any such events in the future. Therefore, if $\xi_t = 1$, then $\xi_{t+j} = 0 \ \forall \ j > 0$.

In addition, the government is subject to a no-Ponzi condition of the form

$$\lim_{j\to\infty} E_t \frac{D_{t+j}}{\prod_{x=1}^{j} R_{t+x}} = 0 \tag{3}$$

The Problem of the Government after Risk has been Realized

Once the risk has been realized, the problem becomes deterministic, since there is no future risk of any additional shocks. This makes the problem tractable. The government chooses a path $\{G_{t+j}\}_{j=0}^{\infty}$ to maximize (1) subject to (2) and (3).

Let's assume that $v(.)$ exhibits constant relative risk aversion (CRRA), and is given by

$$v(G_t) = \frac{1}{1-\rho}(G_t)^{1-\rho} \tag{4}$$

Then the solution to this problem is given by the first order condition, which is the government's Euler equation:

$$v'(G_t) = R_{t+1}\beta E_t\left[v'(G_{t+1})\right] \tag{5}$$

Let's use the superscript a for the period after which the risk has been realized, and b for the period before the shock. The solution to the government's optimization problem after the shock has been realized with the utility function given in (4) is a standard result, and is simply:

$$G_t^a = \kappa B_t \tag{6}$$

where κ is the marginal propensity to spend out of total assets. The marginal propensity to spend is a function of the gross rate of return and the discount factor

$$\kappa = 1 - R^{-1}(R\beta)^{1/\rho} \tag{7}$$

For the purposes of this analysis we impose the condition that $\kappa > 0$ (Assumption 1). This condition essentially guarantees that the present discounted value of government spending remains finite.

The Problem of the Government before Risk has been Realized

In this case the consumer's preferences are the same; however the government's exposure to risk is different.

Consider the case of the government in period t when they have not experienced a shock in the current period. If they still do not experience a shock in the next period, i.e. $\xi_{t+1} = 0$, then government resources in the next period can be represented as

$$M^b_{t+1} = R\left(M^b_t - G^b_t\right) + T \tag{8}$$

We once again obtain the standard Euler equation. Using $i \in \{b, a\}$ to indicate the two possible states (before and after), we get

$$\begin{aligned} v'\left(G_t\right) &= R\beta E_t\left[v'\left(G^i{}_{t+1}\right)\right] \\ or \quad 1 &= R\beta E_t\left[\left(\frac{G^i_{t+1}}{G^b_t}\right)^{-\rho}\right] \end{aligned} \tag{9}$$

We can rewrite the government's Euler equation as:

$$1 = R\beta\left[\left(1-\phi\right)\left(\frac{G^b_{t+1}}{G^b_t}\right)^{-\rho} + \left(\phi\right)\left(\frac{G^a_{t+1}}{G^b_t}\right)^{-\rho}\right] \tag{10}$$

This representation shows that the right-hand side is a probability-weighted average of the growth rates of marginal utility—the first term is the case before the risk is realized, whereas the second term is associated with the case after the risk is realized.

Steady State

First, let's rewrite (10) as

$$\frac{G^b_{t+1}}{G^b_t} = \left(R\beta\right)^{1/\rho}\left[1 + \phi\left\{\left(\frac{G^b_{t+1}}{G^a_{t+1}}\right)^{\rho} - 1\right\}\right]^{1/\rho} \tag{11}$$

To find the steady we must find the loci at which $\Delta G^b_{t+1} = 0$ and $\Delta B^b_{t+1} = 0$. Let's consider the case when the government experiences the shock in period t. Then from (2) we get that

$$B^a_{t+1} = R\left(B^b_t + T - G^b_t - Z\right) \tag{12}$$

Substituting $G^a_{t+1} = \kappa B^a_{t+1}$ into (11) and using (12) we get

$$\begin{aligned} 1 &= \left(R\beta\right)^{1/\rho}\left[1 + \phi\left\{\left(\frac{G^b_{t+1}}{\kappa B^a_{t+1}}\right)^{\rho} - 1\right\}\right]^{1/\rho} \\ \Rightarrow \quad \frac{G^b_{t+1}}{\kappa R\left(B^b_t + T - G^b_t - Z\right)} &= \left(\frac{\left(R\beta\right)^{-1} - \left(1-\phi\right)}{\phi}\right)^{1/\rho} \equiv \pi \end{aligned} \tag{13}$$

By setting $G^b_{t+1} = G^b_t$ we get

$$G^b_t = \left(\frac{\pi\kappa R}{1 + \pi\kappa R}\right)\left(B^b_t + T - Z\right) \tag{14}$$

To ensure that steady state consumption is positive, from (13), we know that we want $\pi > 0$. This condition essentially requires that (Assumption 2):

$$(R\beta)^{-1} < 1 - \phi \tag{15}$$

This ensures that the consumer is sufficiently impatient, and the steady state consumption is positive. Now we turn to characterizing the second equation of the system.

The second equation for steady state comes from the budget constraint in (2) after we set $B_{t+1}^{b} = B_t^{b}$:

$$G_t^b = \left(\frac{R-1}{R}\right) B_t^b + T \tag{16}$$

Equations (14) and (16) together form a system of two equations and two unknowns. Solving them simultaneously yields the steady state target wealth in the before period:

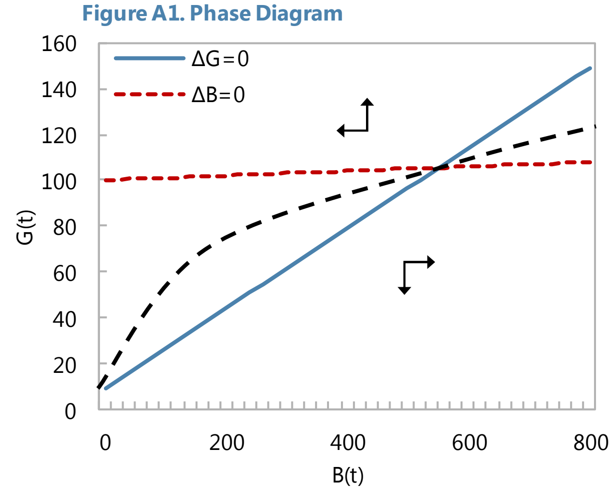
$$B_t^b = \left(\frac{R}{1+\pi\kappa R - R}\right)\left[T + (\pi\kappa R)Z\right] \tag{17}$$

And for steady state government expenditure in the before period we get:

$$G_t^b = \left(\frac{R-1}{1+\pi\kappa R - R}\right)\left[T + (\pi\kappa R)Z\right] + T \tag{18}$$

Figure A1 plots the phase diagram given by the two equations (14) and (16), and the solution in (17) and (18) corresponds to the intersection of the two curves, and represents the target wealth, and government spending in steady state. Here, the stable arm of the phase diagram also represents the government spending function as a function of government assets. This illustrates that the government spending function is concave: the marginal propensity to spend is higher at low levels of assets because the intensity of the precautionary motive increases as resources decline. That is, the marginal propensity to spend is higher at lower levels of assets (B_t^e) because the relaxation in the intensity of the precautionary motive induced a small increase in B_t^e is relatively larger for the government which starts with less than for a government which starts with more resources.

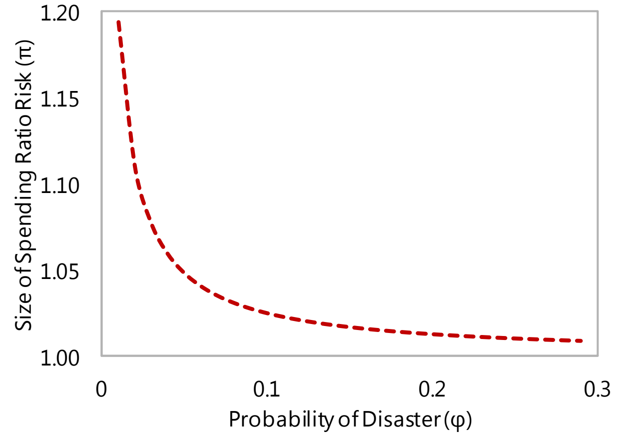
Figure A1. Phase Diagram



Size of Spending Risk

The second graph (Figure A2) represents the size of spending risk, i.e. $\left(G_{t+1}^{b} / G_{t+1}^{a}\right)$ as a function of the probability of the shock being realized in any given period. This graph shows that when the likelihood of the shock is higher, the drop in government spending after the shock is lower. This is because the precautionary incentive motive is much stronger in this case (because the shock is more likely), and therefore in the before period the government engages in much bigger buffer stock saving.

Figure A2. Size of Spending Ratio Risk as a Function of Probability of Contingent Liability Being Realized



This intuition is indeed confirmed when one examines the derivative $\frac{d\left(dB^{b} / dZ\right)}{d\phi}$ in equation (17).

This derivative measures the how the sensitivity of buffer wealth to size of contingent liability changes when we increase the likelihood of the shock. It can be shown that derivative is positive, confirming the intuition that when ϕ increases the buffer saving motive becomes stronger.

Size of Target Buffer Wealth

Here the concept of target buffer wealth is defined as the amount of wealth the government should target due to the contingent liability arising from the financial sector. That is, it is the second term in equation (17). Figure 4 in the main text shows that the target asset as a function of the size of contingent liability. The slope of this is given by the derivative dB^{b} / dZ in (17), which under our assumptions is greater than one. This is a counterintuitive result, since it implies that an increase in the size of contingent liability by one unit, should lead to an increase of greater than one unit in the target buffer wealth. The idea behind this result is that the government spending is financed by both tax revenues and interest payments from the buffer wealth. When the contingent liability gets realized, the size of buffer wealth jumps down by amount Z. This reduces the interest payment the government receives in the post-period, thereby reducing a source of financing government spending in the post-period. Thus, in order to smooth the spending ratio risk (i.e. difference between pre-period government spending and post-period government spending, G^{a} / G^{b}), the government will find it optimal to target a buffer wealth slightly higher than Z.

Transition Path

To find a solution for the transition path, we get two transition equations. First, from the budget constraint in (2) we get

$$B_t = R\left(B_{t-1} + T - G_{t-1}\right) \tag{19}$$

The second equation is obtained by rewriting (10) and substituting $G^a_{t+1} = \kappa B^a_{t+1}$, which yields:

$$G^b{}_{t+1} = \left\{\left(\frac{1}{1-\phi}\right) R\beta^{-1}\left(G^b_t\right)^{-\rho} - \left(\frac{\phi}{1-\phi}\right)\left[\kappa R\left(B^b_t + T - G^b_t - Z\right)\right]^{-\rho}\right\}^{-\frac{1}{\rho}} \tag{20}$$

Equations (19) and (20) form a system of difference equations which together pin down the transition path of the government's problem under study. However, no closed-form solution exists for this problem and we rely on numerical methods to obtain the transition path for a given set of parameters (see Table A1).

Table A1. Parameters

Gross Return (R)	1.01
Discount Factor (β)	0.97
CRRA parameter (ρ)	1
Probability of Shock (φ)	0.01
Tax Revenue to Structural GDP (T/GDP)	0.52
Contingent Liability to Structural GDP (Z/GDP)	0.3

Optimal Government Spending Growth

The next graph (Figure A3) shows government spending growth as a function of total assets on the transition path. When the asset level tends to zero, the precautionary motive becomes arbitrarily large. That is, as assets decline, expected spending growth approaches infinity.

Figure A3. Government Spending Growth as a Function of Total Assets